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Devoted to the Conversion, Transmission and Distribution of Energy

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LEADING ARTICLES IN THIS ISSUE

COST DATA ON SMALL ELECTRIC PUMPS.
BY ROBERT SIBLEY.

LIGHTNING PROTECTION OF TRANSMISSION LINES.
BY ALFRED STILL.

CLASSES OF WEIRS.
BY B. A. ETCHEVERRY.

IRRIGATION—THE GRAVITY WAY.
BY R. B. MATEER.

Publisher's Note: The front cover of this journal will hereafter be used to show the contents of the paper, both editorial and advertising. No further display advertising will be contracted for this space.

The Journal of Electricity, Power and Gas tells by picture and story of the wonderful power projects and electrical developments in that growing empire from the Rockies to the Coast.

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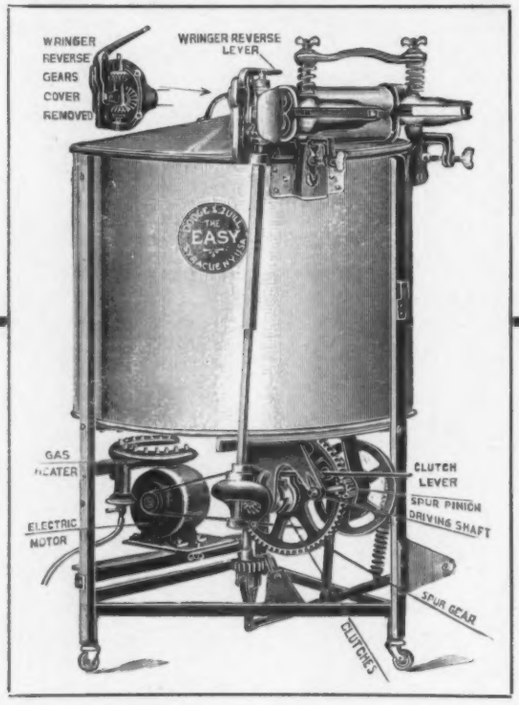
Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**



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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXX SAN FRANCISCO, JANUARY 18, 1913 NUMBER 3

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COST DATA ON SMALL ELECTRIC PUMPS

BY ROBERT SIBLEY.

Definite costs on installing pumps with the necessary electrical equipment can now be computed with much exactness. The district served by the Western States Gas & Electric Company in and about Stockton, California, has recently witnessed an energetic sales campaign to supply electric power to the hundreds of farms in this vicinity. Water can usually be found in sufficient quantities at a depth of between 30 and 40 ft., or less. Here are to be found the great Tokay vineyards of the State, which the experience of the past season has demonstrated presents opportunities for the power salesman.

Near Acampo, on the railroad between Stockton and Sacramento, Walter V. Jahant has installed and put into successful operation a 1600 gallon per minute pumping plant the detailed costs of which will undoubtedly prove of interest to others contemplating a similar installation.

It was at first considered advisable to attempt to pump only 1000 gallons per minute upon a certain portion of this property which was to be set out in alfalfa. As this seemed to have been the upward limit for wells in this district, many thought it inadvisable to attempt the installation of a larger pump. Typical of that spirit of western enterprise, however, Mr. Jahant decided to "go one better" than previous accomplishments had wrought. Consequently twin wells were sunk 22 ft. between centers and the suctions from each well were joined at the center of the horizontal connection. By means of a tee placed at the center of this horizontal pipe connection is made to the pump.

Twin Well Supplying 1500 Gallons of Water Per Minute.

Upon calling for bids for various sizes of pumps, the following general data were given to each bidder:

Pit 12 ft. deep. Water in the morning 7 ft. below pump; at noon 14 ft. below pump; at night 16 ft. below pump. Pump to be installed 12 ft. below the surface.

This preliminary information was compiled from data taken from a gas engine pump on the ranch, situated about 2000 ft. from the proposed well. The following responses from various manufacturers and dealers were received:

Bid No. 1.

We propose to furnish the following material and labor for the pumping plant of Mr. Walter Jahant at Lodi, Cal.: 6 in. horizontal centrifugal pump, Dow or equivalent; 15 h.p., 3-phase, 60 cycle, 220 volt, 1800 r.p.m. General Electric motor, complete with sliding base, pulley and starting compensator with no voltage release. Overload cut out; line switch and fuses; 30 ft. wrought iron 8 in. suction casing; 15 ft. wrought iron 2 in. discharge casing; 6 in. x 8 in. increasing check valve priming pump and fittings; 35 ft. 6 in. Ruboil belting. Also the labor to install and wire the above in a good and workmanlike manner on the customer's foundations, to make a complete and operating pumping plant, for the sum of $475 f.o.b. San Francisco. We will further guarantee the above plant to supply 1000 g.p.m. from a depth of not more than 35 ft. with the above motor, provided the well will give that much water.

Bid No. 2.

We propose to furnish the following material and labor for Mr. Walter Jahant's pumping plant at Lodi: 8 in. horizontal centrifugal pump, Dow or equivalent; 20 h.p., 3-phase, 60 cycle, 220 volt, 1800 r.p.m. General Electric motor, complete with sliding base, pulley and starting compensator with no voltage release. Overhead release; line switch and fuses; 30 ft. 10 in. wrought iron suction casing; 15 ft. 10 in wrought iron discharge casing; 8 in. x 10 in. increasing check valve; priming pump and fittings; 35 ft. 6 in. Ruboil belting. Also the labor to install and wire the above in a good and workmanlike manner on the customer's foundations, to make a complete and operating pumping plant, for the sum of $600 f.o.b. San Francisco. We will further guarantee the above plant to supply 2000 g.p.m. with a Dow pump, or 1600 g.p.m. with a closed runner pump from a depth of 25 ft. or less with the above motor, provided the well will give that much water.

As the 20 h.p. motor gives a very small margin of safety in case the water should drop further than anticipated, we would prefer to figure on a 25 h.p. 1200 r.p.m. motor at an additional cost of $75.

If Mr. Jahant anticipates installing the larger plant, he will probably have to drill two wells and connect them up to a common suction, as it would be exceptional to find one well that would furnish sufficient water for an 8 in. pump. In that case we will be pleased to figure on the additional cost of such a layout of piping when the specifications are decided upon.

Bid No. 3.

We propose to furnish the following equipment: 1-8 in. Byron Jackson or Dow centrifugal pump; 1-20 h.p. Westinghouse or General Electric motor complete with automatic starter, low voltage release switch, wiring, etc., complete, 1-Type H overload relay circuit breaker. The above to be installed complete and ready for operation, including belting, check valve, suction 8 in., with 12 in. dicsharge, for th esum of $699.28. Owner to dig pit-bore well and lay foundation for motor.

No. 3 was the one accepted. It is interesting to see what the complete costs eventually totalled, taking into account, the extras; such as the digging and concreting of the pit and in fact all expenses connected with the installation. These expenses thus considered in detail, were the following:

Tabulation of Cost Data.

Equipment:		
Pump and 25 h.p. motor as per bid	$699.28	
1-35 ft. piece, 8 in. O. D. casing	26.95	
2-9 ft. 5 in. pieces O. D. casing	16.94	
2-8 in. flanged elbows	12.80	
2-8 in. casing flanges	23.93	
5-sets bolts and gaskets	3.55	
1-8 in. tee	20.63	
Extra labor	10.00	
		$814.08
Concrete Work: (This consisted of concreting the entire interior 4 in. thick, reinforced, with 5 pieces tapering from 12 in. to 0 in. No cost is made for the sand, as this was taken from the well-boring sand, being found of excellent quality. The gravel was hauled 15 miles and no actual cost being made for the gravel itself).		
Gravel:		
4 horses, 4 days at $1.00 per day	$ 16.00	
Labor: 1 man, 4 days at $2.25 per day	9.00	
Cement: 61 sacks at 65c per sack	39.65	
Cartage on cement—2 horses and 1 man ½ day	3.25	
Labor on setting concrete	21.00	
Concrete forms 2 men 2½ days at $2.25 per day	13.00	
Lumber for concrete forms and for pump house, 1,000 ft. at $25.00	25.00	
		126.90
Pump House (lumber used from concrete forms):		
3500 shingles at $2.50 per M	$ 8.75	
Sheeting	5.00	
Labor on building	13 25	
Nails	1.00	
		28.00
Main Excavation:		
Pit 10 ft. deep, 10 ft. wide, 6 ft. to runaway	$ 24.75	
Cost of second pit and levelling off first pit	25.25	
		50.00
Well Sinking:		
Boring two wells 12 in. diameter—150 ft. and the other 350 ft. deep over surface of the ground	$ 63.25	
(Usual charge is for ⅛ pit depth, but in this case, charges were made for 40 and 43 ft., respectively).		
Cost of pumping quicksand encountered, 6½ days at $14.00 per day	91.00	
Express charges	9.00	
		163.25
Priming Pump:		
Priming pump	$ 5.00	
Iron ladder consisting of 9 pieces 2 ft. 6 in. x ¾ in.	1.50	
		6.50
Grand total		$1,888.73

This pump is now in successful operation. As may be seen from the illustrations shown herewith, an eternal insurance against a recurrence of a dry season is thus ever at hand.

REPORT OF OREGON CONSERVATION COMMISSION.

The fourth annual report of the Oregon Conservation Commission to the Governor shows that unused streams in Oregon are capable of producing 3,300,000 h.p. These streams are also capable of supplying water to irrigate fully 4,000,000 acres of land, half of which can be irrigated at a cost of $30 to $60 per acre. Of the 686,129 acres of irrigated land in the state, 3.2 per cent has received water through the U. S. Reclamation Service, 3.6 per cent through the Carey Act, 11.3 per cent through commercial enterprises and most of the balance through individual or partnership enterprise.

The Commission recommends submission to the people of a constitutional amendment poviding for a bond issue for irrigation and water power development by the state in co-operation with the U. S. Geological Survey. It also recommends state construction and control of sufficient power projects to regulate the market and insure cheaper power.

The report contains the complete text of the Water Code of Oregon with comments on its operation. The law has greatly stimulated investments, and the determination and recording of early rights has progressed rapidly. Twenty-three separate stream systems have already been surveyed, involving about 275,000 acres of irrigated land. Over 2000 claims to water have been filed with the Board of Control, and complete determinations made on fifteen stream systems, affecting 1018 separate rights and 106,686 acres of irrigated land.

LIGHTNING PROTECTION OF TRANSMISSION LINES

BY ALFRED STILL,
Member A. I. E. E., Inst. E. E.

Spark-Gap Arresters With Circuit Breakers or Re-Setting Fuses.

If the resistance in series with a gap arrester is very small, a good path is provided to ground for taking a very heavy discharge; but there will be a large flow of power current in the arc following the discharge. This current may be interrupted by connecting some self-acting device such as a fuse or automatic circuit breaker in the ground connection; and arresters, whether of the horn type or with any other kind of spark gap, are now made with fuses so arranged that when one fuse blows, the dropping of a lever or an equivalent device, automatically inserts another fuse, so that the system is not left unprotected. Even without automatic replacement, if a number of gaps with fuses are connected in parallel, it will generally be found that one discharge will not blow all the fuses, and that during the passage of a single storm, the line will be adequately protected.

In the Garton-Daniels arrester, for use on a.c. circuits up to 20,000 volts, the principle of the multiple

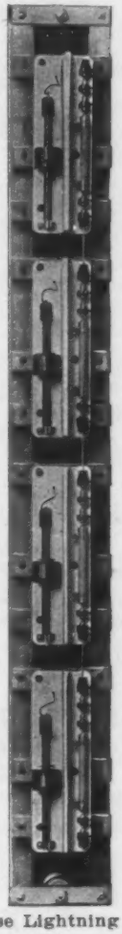


Fig. 5. Single-Phase Lightning Arrester for 10,000 Volts.

gap is combined with a simple type of automatic circuit breaker connected as a shunt to some of the spark gaps, in order that the discharge path for the lightning shall remain unaltered even during the operation of the arrester. The arrester is built up of several unit parts connected in series; each unit being rated for 3300 volts. The ilustration, Fig. 5, shows a complete single-phase arrester for 10,000 volts. On a 20,000 volt

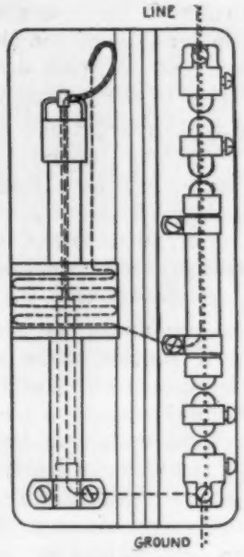


Fig. 6. Diagram of Single Unit of Multiple Arrester.

circuit, there would be eight units in series, the total air gap distance being 1⅛ in., with a series resistance averaging 3800 ohms. The diagram Fig. 6 refers to a single unit of the Garton-Daniels arrester. The discharge follows the straight path through the two sets of air gaps and the resistance rod, as indicated by the round dots. The power current following the discharge will, after passing through the two upper gaps and the resistance rod, be shunted by the low resistance winding of the circuit breaker; and if this following current is too heavy to be ruptured by the combined action of these two gaps and the resistance rod, the iron armature of the circuit breaker will be lifted by the action of the solenoid, thus throwing the two lower spark gaps in series, and extinguishing the arc.

Aluminum Cell Arrester.

When two aluminum electrodes are immersed in a suitable electrolyte, an insulating film of hydroxide of aluminum is formed on the surface of the metal, which effectually prevents the passage of any appreciable amount of current until a certain critical voltage is reached, when this film breaks down and the current is limited only by the resistance of the electrolyte. On lowering the voltage, the film is re-formed and the flow of current again limited to a very small amount.

With alternating currents, the critical voltage per pair of plates is about 350 volts, and the practical construction of lightning arresters on this principle consists in stacking a large number of cone-shaped aluminum plates one within the other, with suitable separating washers of insulating material between them. In this manner a column is formed of a large number of cells in series, capable of withstanding high volt-

ages. The whole is enclosed in a cylindrical case containing oil, which improves the insulation and prevents the evaporation of the electrolyte which fills the spaces between adjacent trays within a short distance of the edge.

If cells built up in this manner are connected directly between line and ground, there will be an appreciable current passing through them, which is partly a leakage current, but chiefly a capacity current. It is therefore customary to insert a spark gap, usually of the horn type, in series with the aluminum cell arrester; the gap being set to break down with a pressure slightly in excess of the normal working voltage.

Although the film of hydroxide is formed on the plates at the factory before the arresters are installed, it is necessary to maintain it by periodic "charging" of the cells; this being done by closing, or nearly closing, the spark-gap in series, so as to put the full line pressure across the arrester. It is generally recommended that this be done once every day.

In principle the aluminum cell arrester would appear to offer an ideal solution of the problem of lightning protection; because, once the critical voltage is exceeded, and the film broken down, a very large current—depending on the amount of separation and the area of the plates, and also the nature of the electrolyte—is allowed to pass to ground; and the device is capable of dealing with continual surges, such as will occur with an intermittent ground, for a period of about half an hour without excessive heating. In practice it has proved fairly satisfactory, especially on the higher voltages; but, apart from its large initial cost, it has frequently been found to be somewhat costly in upkeep, as the aluminum cells are liable to become damaged through frequent and heavy discharges, and have to be periodically reformed or replaced. Then again, the necessity of charging with the line current is an objection where there is not an operator constantly in attendance; and lastly, it must not be overlooked that the device suffers from the disadvantage common to all spark gap devices, namely that high frequency surges are liable to be set up in the system when the spark gap discharges. In this particular case the trouble is liable to occur, not only when the horn gap breaks down while fulfilling its function of discharging an excess of pressure through the cells, but also when the spark is deliberately formed for the purpose of charging the cells. On very high pressure systems it is possible that the surges set up by spark gaps in series with the resistance of the cells are not likely to cause trouble; but this suggests the possibility of simpler and less costly devices such as the graded horn gaps previously referred to, being equally effective. On the other hand, when used on low voltage systems operating at about 11,000 volts, (especially if the generators are directly connected to the transmission line, without the intervention of step-up transformers) the operation of charging the aluminum cell arresters in the generating station has been known to break down the insulation of the generators.

Condensers.

Although much has been done, and more good work will probably be done in the future by the intelligent "grading" of a number of spark gaps, to afford a path to ground and yet avoid the setting up of dangerous high frequency surges, the objections to all spark gaps are (1) the necessity of an appreciable increase in pressure above normal line pressure to break down the resistance of the gap, and (2) the danger of an oscillatory current being set up in the network of conductors.

Consider any single spark gap, such as the horn type, with a resistance in the ground connection. If this resistance is less than twice the quantity which Dr. Steinmetz has named the natural impedence of the circuit, the interruption of the current passing to ground is liable to set up dangerous high frequency oscillating currents in the wires and apparatus connected thereto; and, on the other hand, if the resistance is greater than this critical value, it may be too high to afford much relief in the event of suddenly applied electric impulses.

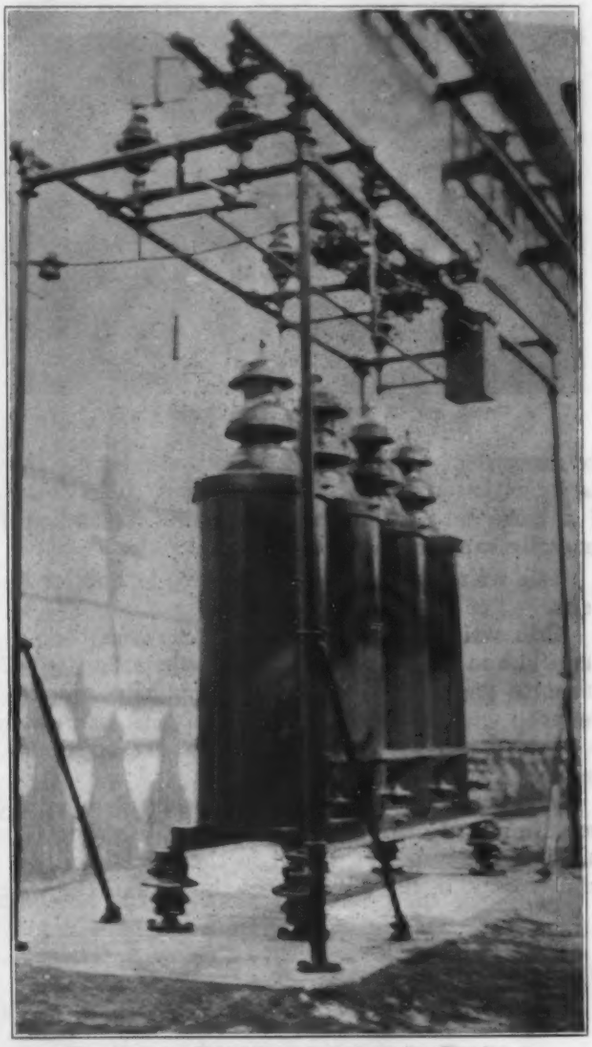
As stated at the beginning of this article, the natural impedence of a circuit is the square root of the ratio $\frac{\text{inductance}}{\text{capacity}}$ or $\frac{L}{C}$ which, in the case of overhead transmission lines will have a numerical value between 200 and 500 ohms. Assuming this to be 350 ohms, it will be seen that the resistance in the ground connection must be at least twice 350, or (say) 800 ohms in order to avoid the production of high frequency oscillations.

If the spark gap can be avoided, this high series resistance in the ground connection becomes unnecessary. A non-inductive direct connection to ground can obviously not be made on a high tension alternating current overhead transmission line; but a path to ground may be provided either through a highly inductive choke coil, or through a condenser, or both, without the necessity of providing a spark gap in series. The inductive resistance may easily be designed to pass only an inappreciable current of the normal or higher frequency, and it will therefore be useless as a means of relieving the line of a static charge. The condenser, however, acts as an almost perfect insulator so far as direct currents are concerned; but it is pervious to high frequency currents, and a suitably designed condenser, or rather battery of condensers, connected between line and ground without the intervention of any spark gap is certainly an ideal device for dealing with the very high frequency oscillations that accompany lightning phenomena. This is the chief function of the Mosciki condensers which, although not largely used on this continent, have found favor in Europe, where they have been in use for many years in almost every country, and also in South Africa and China.

As previously stated, the travelling waves induced by a lightning discharge on a transmission line have a frequency of the order of 1000 to 5000 cycles per second, and a set of condensers which will not pass any but a very small current at 25 or 60 cycles, will deal with much larger currents on these higher frequencies. As a matter of fact, an electric discharge between cloud and ground or between cloud and cloud may induce in the line travelling waves having frequencies considerably in excess of 100,000 per second. This is proved by the fact that wireless telegraphic apparatus which

responds only to frequencies ranging between about 100,000 and 1,000,000 cycles per second is interfered with by atmospheric electric storms. A 40 ampere fuse in series with a condenser has been blown during atmospheric discharges although the condenser could not possibly pass more than a hundredth part of this current on frequencies of 3000 to 4000.

It is perhaps not generally understood that high frequency travelling waves may break down the insulation of generators or transformers even when the voltage of these induced charges is small as compared



Electrolytic Lightning Arresters in Use by a Western Power Company.

with the normal operating voltage. The trouble is that the wave is short; it has a steep front, and the point of zero potential may be only a few hundred feet behind the point of maximum potential. If, therefore, a travelling wave of this nature enters a piece of electrical machinery such as a generator or transformer, the full difference of potential, which may amount to only a few thousand volts, may be applied across adjacent layers of the coil winding, thus causing a puncture and ultimate break down of the insulation, even if the apparatus as a whole is insulated to withstand pressures of 100,000 or 200,000 volts to ground. As a protection against trouble of this sort from high frequency induced charges, the condenser appears to offer a good solution.

It must not be understood from the foregoing notes on the uses of condensers as lightning arresters that the discharge is diverted to ground through the condenser and so dissipated, much as energy would be dissipated in a resistance, because the condenser cannot absorb or dissipate any but the smallest percentage of the energy passing through it. The energy is necessarily re-delivered to the line from which it originally came, and is ultimately dissipated through the ohmic resistance of the conductors; but the steepness of the wave front has been diminished. The function of the condenser is, in fact, somewhat analogous to that of an air chamber on a water pipe in which the rate of flow is subject to sudden variations.

U. S. FORESTER'S REPORT ON WATER POWERS.

The annual report of U. S. Forester Henry S. Graves estimates that about 12,000,000 h.p. can be developed from the natural flow of streams in the national forests. This amount can be increased greatly through the regulation of stream flow by storage. Numerous excellent reservoir sites are available.

The regulations adopted by the department on December 28, 1910, have now been in force long enough to demonstrate their practicability. On the whole, they are favorably received by developers. The propriety of making a charge for the use of the land occupied and the reasonableness of the amount fixed by the regulations is generally conceded. That feature of the permit which requires development to be made within a reasonable time is working satisfactorily and is serving to keep out speculators who have hitherto sought to appropriate sites only that they might later dispose of them to the real developer.

The following table shows the extent to which water power development is taking place on the national forests:

	Transmission lines only.	Reservoirs, conduits, power houses.
Permits in force June 30, 1912:		
Commercial—Preliminary	..	39
Final	73	84
Noncommercial	5	62
Total	78	185
Projects operating June 30, 1912:		
Commercial	60	56
Noncommercial	4	28
Total	64	84
Projects on which construction had begun June 30, 1912:		
Commercial	6	29
Noncommercial	...	16
Total	6	45

	Transmission lines only.	Reservoirs, conduits, power houses.
Permits issued from July 1, 1911, to June 30, 1912:		
Commercial—Preliminary	..	29
Final	22	26
Noncommercial	..	16
Total	22	71
Applications received from July 1, 1911, to June 30, 1912:		
Commercial—Preliminary	..	46
Final	20	25
Noncommercial	3	21
Total	23	92

ELECTRICAL PUMPING AND IRRIGATION

CLASSES OF WEIRS.

BY B. A. ETCHEVERRY.

Diversion weirs belong to two general classes, closes weirs and opened weirs.

Closed weirs are weirs built solidly across the rivers so that the entire stream flow passes over it. To this class below the brush weirs, cobble weirs, pile weirs, crib weirs, either continuous or built up of separate cribs, wooden frame weirs, steel frame weirs, reinforced concrete weirs, concrete or masonry weirs, and loose rock weirs of Indian type.

Open weirs are weirs built across the river so as to afford least obstruction to flow. They may consist of piers or columns with the opening between controlled by gates or may be collapsable gates with no piers. To this class belong the following:

Wooden frames or buttresses with openings controlled by flashboards.

Wooden frames or buttresses with openings controlled by lift gates.

Concrete or reinforced concrete buttresses or columns controlled by wood or steel gates.

Small Combination Crib Diversion Weir and Fish Ladder in British Columbia.

Steel frames with openings controlled by wood or steel gates.

Collapsable gates.

The selection of the type of weir will depend on the character of stream flow, the effect of the weir on the lands above the weir, the character of foundation, the permanency desired and amount of money available, and the availability of the material of construction. An open weir is to be used in preference to a closed one where the obstruction formed by a closed weir would cause flooding of land above, or formation of islands on the upstream side of the weir. Collapsable weirs are used where the obstruction of piers or columns must be prevented, such as where the volume of flood flow and the amount of floating debris is great. Closed weirs are self acting, do not require operation of gates and will permit the passage of ice, trees and other floating material which would obstruct the openings of an open weir.

Brush and cobble weirs are generally used for temporary low weirs and may require yearly renewal. They are used where cobbles are plentiful and where

Brush nad Cobble Dam Near Rumsey, Cal.

the amount of money available and the character of the irrigation system will not justify the expenditure of a more substantial structure. The foundation is generally sand, cobbles or boulders.

Pile weirs are used on sandy streams and for low weirs.

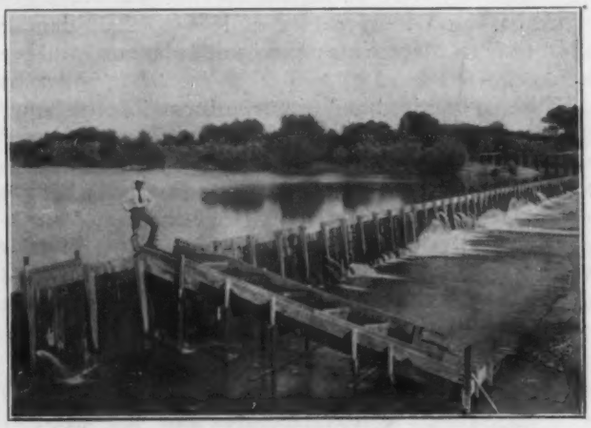
Crib weirs are used where lumber and rock are plentiful and preferably where the stream flow is sufficient to pass over the weir continuously and keep the wood wet. Weirs built of separate cribs are easier to construct in flowing water than are continuous weirs.

Wooden frame weirs are used where lumber and rock are not plentiful. They consist of a strong floor nailed to heavy pieces placed in the bed of the river and across it in the direction of the axis of the weir,

Low Concrete Diversian Weir and Headgate Showing Formation of Sand and Gravel Islands on Upstream Side, Due to Great Length of Weir and Absence of Scouring Sluices, Umatilla, Ore.

to which is belted and fastened the wooden frame which supports the sheathing which forms the up-

stream face of the dam. The stability of this dam depends mainly on the pressure of water on the upstream face. The slope of this face should not be steeper than 1 vertical to 2 horizontal. When the foundation is sand sheet-piling is driven along the upstream and downstream edge of the floor and good connection made with the floor. The sheet-piling should be driven in the sand a depth equal to about twice the height of water on the upstream side of the dam. The floor should extend far enough downstream to protect the bed from the erosion caused by the falling water. When the foundation is rock the floor should be bolted to it and good connection made with it at the upstream and downstream edge of the floor.



Removable Flashboard Diversion Weir of Moore Ditch, Yolo County, Cal. Courtesy of Irrig. Investg., U. S. D. A.

Steel frame weirs are similar to wooden frame weirs but more durable.

Reinforced concrete weirs are usually cheaper than solid concrete weirs and are better on a foundation other than solid rock because of their greater elasticity. In some cases the high cost of concrete because of inaccessibility may prevent the adoption of any type of concrete weir.

Concrete and masonry weirs have the great advantage of strength and durability but their use is largely limited to solid rock foundations. Concrete weirs of the Ogee type are satisfactory on solid foundations. Concrete weirs with direct vertical fall on a thick apron or in a water cushion are well adapted to loose soft foundation.

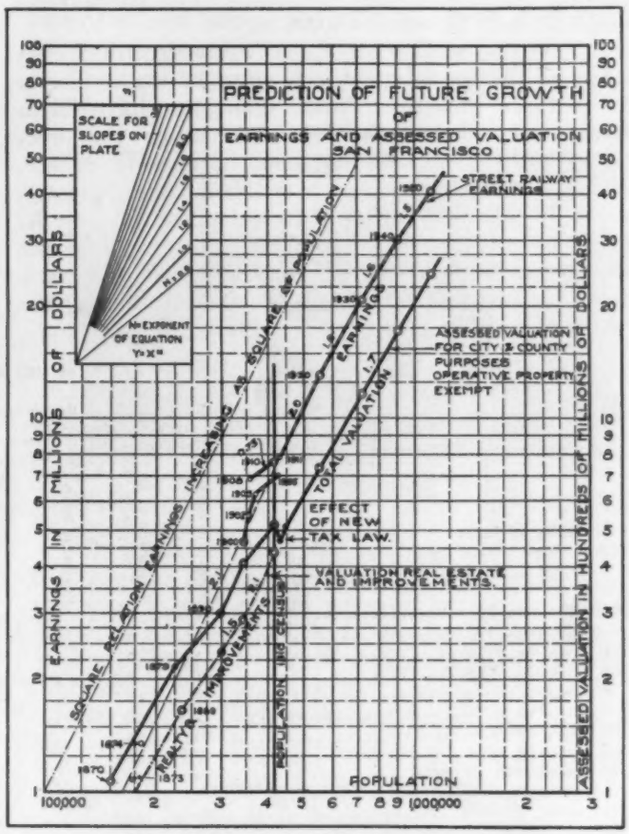
Loose rock weirs of the Indian types are especially suitable for unstable soft foundations and where a large volume of water passes over it during flood time.

The various types of open weirs differ mainly in the material used and in the size of the openings between piers or buttresses. The material available and the amount of money which one is justified in spending will largely determine whether wood, steel or concrete should be used. The character of stream flow will determine the desirable size of opening. Where the stream carries a great deal of floating debris or ice the openings should be made to prevent obstruction and the following types of construction may be necessary.

1. Make the operating platform removable for at least a portion of the weir.
2. Provide a wide log way.
3. Make a porton of the weir collapsable.

SAN FRANCISCO'S PREDICTED TRANSIT GROWTH.

Bion J. Arnold's Preliminary Report No. 19 to the Board of Supervisors of San Francisco is concerned with the growth of traffic and investment in transit facilities, giving an exhaustive analysis of past and present growth and a conservative prediction of future requirements. The conclusion is that if the city of San Francisco declines to accept the assistance of private capital in financing its utilities a revision


PREDICTION OF FUTURE GROWTH OF EARNINGS AND ASSESSED VALUATION SAN FRANCISCO
SCALE FOR SLOPES ON PLATE
N= EXPONENT OF EQUATION Y=X^N
STREET RAILWAY EARNINGS
ASSESSED VALUATION FOR CITY & COUNTY PURPOSES OPERATIVE PROPERTY EXEMPT
EFFECT OF NEW TAX LAW.
VALUATION REAL ESTATE AND IMPROVEMENTS.
SQUARE RELATION EARNINGS INCREASING AS SQUARE OF POPULATION
POPULATION
DOLLARS
MILLION
EARNINGS
ASSESSED VALUATION IN HUNDREDS OF MILLIONS OF DOLLARS

Analysis of Mathematical Law of Growth.

Upon this law rests the future of the city in respect to transit earnings and investment in the necessary railway properties. It answers the question. How fast will earnings and investment grow with reference to the population? San Francisco has exceeded many other cities in the past, with earnings growing faster than the square of the population; and valuation of property somewhat below this rate. This means that when the population doubles, property valuation more than triples, and earnings quadruple. The broken guide line indicates the square relation. A line parallel thereto conforms to this law. For the distant future the rate of earnings has been conservatively decreased, as this study refers largely to surface transportation, and not including expensive rapid transit projects.

of the present $51,000,000 bond limit must be secured immediately in order to provide the capital necessary for preserving the normal rate of growth of the city. It is predicted that by 1930 the railway investment required will be $62,000,000 and by 1059, $123,000,000.

It has been found that the total annual railway earnings increase approximately as the square of the increase in population. This relation is shown graphically in the accompanying chart. It is stated that the earnings of the United Railroads should double in the

next 13½ years—i.e. should reach $16,000,000 by 1924-5—and should quadruple by 1942. Earnings per capita are now the highest in the country—$20 per capita for all companies.

An analysis of growth shows that San Francisco is now growing faster than during the five years before the fire, and at a rate of increase about 145,000 per decade. The real growth of the city, excluding the effect of the fire, has been at the rate of 54 per cent for the last decade, as against 22 per cent shown by the census. At the present time the city contains about 450,000 people. This population will double in 26 years, and will reach 1,000,000 people in 1945. The San Francisco commuter district now has a population of 728,000 people, and has increased 48 per cent in the last decade. This population will double in 23 years, reach 1,000,000 in 1919, and 2,000,000 in 1945.

Since the publication of this report some little criticism has been made of the lowness of the estimates for future growth. These estimates have been made for the purpose of anticipating the necessary railway facilities and are necessarily conservative. It is interesting to note that they average about 15 per cent higher than did those of John R. Freeman in the preparation of his report on the water requirements of the city. In the extension of track mileage San Francisco is at least six years behind the necessities of the growth in population.

POSSIBILITY OF MINE EXPLOSIONS FROM INCANDESCENT LAMPS.[1]

BY H. H. CLARK.

Electric incandescent lamps are used in a large number of mines. Almost all mines in which electric current is availabie use electricity to some extent for underground lighting. The design and construction of incandescent lamps is such that, when properly installed, they offer ordinarily only a small fire hazard, because the filaments are so quickly broken to pieces when the bulbs are fractured that there is not time to raise to its ignition point material that is merely combustible. The presence of explosive mixtures of gases, however, increases the risk. When an incandescent lamp bulb is broken in an explosive mixture of gas this mixture is brought into violent contact with a wire having a temperature of 1800 to 2000 degrees C., or two to three times the ignition temperature of methane.

Twelve hundred and nineteen incandescent lamps, representing the product of eight manufacturers, were used in the investigation. The lamps were similar to those used for general lighting purposes wherever electric incandescent systems are operated.

The results of the tests are given below in tabular form. This table shows the number of tests of each kind made on each size of lamp and the percentage of ignitions that took place.

Table 3.—Number of tests and percentage of ignitions.

Rating of lamp.	Smash test rated voltage.		Smash test; overenergized lamp.		Smash test; percentage of gas varied from 8.6 per cent		Tip-breaking test.		Puncture test.		Naked filament test.	
	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.	Number of tests.	Percentage of ignitions.
8 candlepower, 50 volts	4	0	6	33	..	.....	5	0	...	.....	..	...
8 candlepower, 55 volts	5	0	3	0	..	.....	5	40	4	100	4	100
30 watts, 50 volts	4	0	6	66.7	..	.....	5	40	...	.....	..	...
30 watts, 55 volts	24	8.3	36	58.3	..	.....	10	30	10	80	..	...
16 candlepower, 55 volts	16	18.7	...	....	..	.....	3	0	2	100	4	100
50 watts, 55 volts	4	25	...	....	..	.....	...	.....	...	.....	..	...
60 watts, 50 volts	10	80	...	....	..	.....	...	.....	...	.....	..	...
60 watts, 55 volts	20	95	...	....	28	60.7	15	60	...	.....	..	...
32 candlepower, 55 volts	5	100	...	....	3	100	8	75	5	60	4	100
100 watts, 55 volts	2	100	...	....	..	.....	...	.....	...	.....	..	...
120 watts, 55 volts	10	100	...	....	24	75	5	60	...	.....	..	...
50 candlepower, 55 volts	7	100	...	....	..	.....	...	.....	...	.....	..	...
155 to 175 watts, 55 volts	8	100	...	....	..	.....	10	80	...	.....	..	...
8 candlepower, 110 volts	8	12.5	18	50	..	.....	7	0	3	100	3	100
25 watts, 110 volts	2	0	6	33.3	..	.....	...	.....	...	.....	..	...
30 watts, 110 volts	12	0	36	44.4	..	.....	15	13.3	15	46.7	..	...
16 candlepower, 110 volts	8	0	19	52.6	3	0	8	12.5	3	100	4	100
50 watts, 110 volts	12	8.3	3	66.7	..	.....	...	.....	...	.....	..	...
60 watts, 110 volts	32	9.4	36	41.7	7	14.3	15	13.3	10	60	..	...
32 candlepower, 110 volts	6	50	...	....	..	.....	2	0	2	100	3	100
32 candlepower, 127 volts	8	62.5	...	....	..	.....	...	.....	...	.....	..	...
100 watts, 110 volts	4	75	...	....	..	.....	5	60	...	.....	..	...
120 watts, 110 volts	48	50	2	50	5	80	15	33.3	...	.....	..	...
50 candlepower, 110 volts	7	85.7	...	....	..	.....	5	100	...	.....	..	...
155 watts, 110 volts	4	100	...	....	..	.....	5	40	...	.....	..	...
175 watts, 110 volts	4	100	...	....	..	.....	5	20	...	.....	..	...
8 candlepower, 220 volts	3	0	8	25	..	.....	5	20	2	100	3	100
25 watts, 220 volts	14	0	42	21.4	..	.....	20	5	18	44.4	..	...
16 candlepower, 220 volts	5	0	12	41.7	..	.....	11	0	5	40	4	100
60 watts, 220 volts	22	4.5	42	57.1	..	.....	15	13.3	15	66.7	..	...
32 candepower, 220 volts	7	0	16	56.3	..	.....	3	33.3	3	66.7	4	100
120 watts, 220 volts	44	2.3	42	50	..	.....	20	20	10	80	..	...
50 candlepower, 220 to 225 volts	20	80	...	....	..	.....	6	66.7	2	100	2	100
100 watts, 220 volts	16	68.7	...	....	..	.....	10	50	...	.....	..	...
20 watts, 110 volts	7	85.7	...	....	..	.....	4	75	...	.....	..	...
20 watts, 220 volts	14	28.6	...	....	..	.....	6	0	...	.....	..	...
Total	426	.....	338	....	68	.....	248	.....	109	.....	35	...

[1]Abstracted from Tech. Paper 28, just issued by the Bureau of Mines.

READINESS TO SERVE METHODS

IRRIGATION.—THE GRAVITY WAY.

BY R. B. MATEER.

"Back to the land" and the hunger of American people to own some land, the ever-increasing price of land in the Middle West and the restless energy of the sons of pioneers of a section, contribute proportionately to the continued tide of immigration westward where land is to be secured at a reasonable figure. As the colonist crosses the range, his attention is drawn to the arid land, baking in the hot sun, or to the swamp land partially covered with water, yet possessing a fertility far surpassing the Nile and its deltas. Backward travel his thoughts to other lands from which only a modest bank account represented the wage of years of toil. Will it pay to heed the cry and try to wrestle from the arid soil a living or wealth?

Determined to enter the lists and convinced that the one essential is water, thought is given to its source, the magnitude of its supply, and how obtained. Will it be by following the old methods of gravity irrigation, or will the conditions of supply compel a system that will assure water when and where demanded and at a moments' notice?

Gravity System.

The farmer who has suffered repeated failure of crops suddenly awakes to the creek peacefully flowing through his land and hastens to construct a crude earthen breastwork to retain the flow and divert it through flumes, or ditches, over the parched soil, and noting the stimulus given the grain, advises his neighbor, who perhaps seeks the same source of supply, and soon the stream reveals, by reason of the heavy demand on it, nothing but a dry channel.

Knowing that the springs are inexhaustible, a company is formed and reservoirs are constructed at a great cost to retain the winter's floods that a supply of water is available for use in the summer.

The irrigation district, thus formed, is possible only by filings on the flow of the river and by each land owner purchasing a stock interest in the reservoir and the ditch proportionate to the amount of water demanded for his land. But repairs are necessary. The ditch must be strengthened, to prevent undue loss by seepage, and an assessment is levied on the farmer, year after year. Expensive when a comparison is made between the earning power of the land and the rate per acre assessment.

Hungrily others, promoters and farmers, gauge the flow of the stream, and through other filings construct huge canals to derive some profit from their land, diverting water from those who hold prior filings, appropriating their portion of the flow generously granted by nature, and claiming all the water originating in a territory as their heritage for gravity irrigation purposes. Another season of drought and restrictions are placed on the water and its use. The headgates are only opened certain days in the month and only a limited quantity of water is used for irrigating purposes, but still the assessments continue and the ditch, dry and parched, in the glare of the sun's rays, yields no water when needed.

To overcome this condition, a reorganization of the company occurs and other reservoirs are built to insure a steady supply of water for old established systems, seeking to overcome the increasing scarcity occasioned by the many filings on the water and the zeal with which more acreage is added to that at present under irrigation.

Cost.

Gravity irrigation usually involves the expenditure of at least $50 per acre investment in ditch rights, plus a maintenance charge of at least $1.25 per acre, or $4.25 per acre per year when interest is figured at 6 per cent.

Typical Gravity Irrigation Ditch.

On some projects, the cost per acre investment is as high as $100 per acre and the maintenance $1.50 per acre, a total charge per year of $6 per acre for water, the use of which is limited by the flow of streams, the requirements of his neighbors, the contour of the land and the location of the ditch, with reference to the high spots and the care given to the ditch to prevent undue seepage.

Water—A Potent Factor.

Irrigation by storage reservoirs and gravity has perhaps suffered more from the numerous fake land schemes, the promised development of irrigation systems which never materialized, the filing of claims on water already appropriated than by reason of construction defects. Yet, as irrigation is destined to become one of the most important, if not the most important economic factor of this country, will not water, where and when desired, become a potent factor in controlling the value of securities, of elections, and, in fact, act as a governor regulating the stability of the nation, due primarily to its necessity for the production of crops? Knowing the condition of crops to hinge largely on water and its supply, is it not therefore of vital importance to the nation that irrigation be accomplished in such a manner as to utilize, not alone the surface water, but the underground flow, removing the limits usually surrounding all but the most favored farms, drawing from the earth's storehouses, with electrically operated pumps, the liquid nature is "ready to serve"?

THE SIGNIFICANCE OF DEBT PAYING METHODS OF PUBLIC SERVICE CORPORATIONS.

BY F. K. BLUE.

If proper dividends, which are commensurate with the risk involved as indicated by the price offered for preferred stock when issued, have been distributed, the payment of the debts of a public service corporation out of a sinking fund will increase the market value of the stocks of the corporation, and so to that extent amounts to an unearned increment which is enjoyed by the shareholders at the expense of the consumers who have paid this amount to the corporation in excessive rates. This amount also represents a physical property value that was never obtained by cash actually invested by the stockholders.

Suppose 7 per cent on the market value of outstanding stock be the commercial appraisal of a straight investment in the properties and prospects of the corporation, and this amount is paid in dividends, and that eventually 3 per cent of such valuation is set aside for a term of years and is finally expended in the payment of a bonded indebtedness (this operation not having been anticipated in the offers for the original stock issues.) The payment of these bonds should then increase future earnings by the amount of interest saved, and therefore the market value of the outstanding stock should increase commensurately. So the whole transaction from an economic standpoint is equivalent to a payment of a 10 per cent dividend to the stockholders during this period, 3 per cent of which is reinvested in the property and prospects of the corporation. Although the number of outstanding shares has not been changed, the physical value of the corporation property which is represented by the outstanding stock has been increased and its earning power is greater. Two shares of common stock at 40 is, as far as investment is concerned, equivalent to one share at 80 when the same proportion of physical value and earning power is represented in each case. Although the nominal capitalization remains the same, the real capitalization has been increased, and the physical valuation upon which in a rate fixing suit the courts would award a "reasonable return on investment," has been increased by funds which were virtually distributed to the stockholders in the past in excess of a "reasonable return on investment." A sinking fund used in the retirement of bonded indebtedness may then be regarded for all practical purposes as equivalent to a payment of dividends to stockholders.

On the other hand, the payment of bonds by means of new bond or stock issues requires a new investment of actual cash from without, to replace a previous investment of cash. If the new securities are in the form of bonds, the economic conditions have not been altered, except that the conditions may be more or less favorable to the corporation in regard to interest charges. If they are in the form of stocks the nominal capitalization has been increased, but the real capitalization remains substantially unaltered. Before the transaction, the capitalization represented the physical value of the properties less the par value of the bonds. Afterwards, the increase in nominal capitalization represents the physical value formerly represented by the bonds that are now retired. If the return demanded on the stock is greater than the return demanded on the bonds, a surplus should have been accumulated to be applied in part payment of the bonds so that the market value of the stock would not be affected by the transaction, and the sale of the new issue at such market value would provide the remainder of the fund required to retire the bonds. The existing investors are thus protected against loss and the new investors come into the corporation on equal terms, while the consumer is not affected in any way by the transaction.

The payment of bonds out of a sinking fund is exactly the same from an economic standpoint as the investment of surplus in extensions and betterments, the practical difference lying only in the time at which the property is brought under the control of the corporation. In one case, such property, although under the control of the stockholders, is really purchased by the stockholders and not paid for by the stockholders until the bonds are retired by funds derived from earnings. In the other case, the property does not come under the control of the corporation until paid for by the stockholders by funds derived from earnings. Aside from the often erroneous attitude of the public, it is immaterial as far as economic values are concerned whether such property is represented by stock dividends to the stockholders or by a resulting rise in the market value of the outstanding stock already issued. In one case the stockholder enjoys his slice of "melon" in dividends on new stock of the same market value, while in the other case he gets it in the rise in the market value of his old stock due to the increase in the dividends on its par value, which results from the relief from interest payment on the bonds that were retired.

In cases where service rates are fixed by a commission or similar body, such application of sinking funds or surpluses is made really at the expense of the consumer, since he is thereby forced to pay a profit on property which he has himself already actually contributed, and which in the case of municipal purchase he would practically be required to pay for twice. Surplus reserves are valuable and necessary in strengthening corporation credit, balancing operating expense against fluctuating revenue, and maintaining uniform dividends, but they should finally be distributed as ordinary or deferred dividends, used in the purchase and retirement of outstanding stock of the corporation (rate reductions following), or applied to the credit of the consumer in the purchase of the property by the public. Such reserves should not be allowed to grow so large, however, as to result in the collection of wealth from the consumers of one generation for the benefit of the consumers of the next.

When service rates are invariable or are fixed by the corporations to conform to conditions of maximum profit, it makes no difference to the existing consumer whether the surplus reserves are distributed to the stockholders as dividends, applied in payment of bonded indebtedness, or invested in extensions and betterments, except when the rate conditions for maximum profit are altered or betterments affect his service at the same rates. In such cases the corporation can no more help changes in the value of its stock than an owner in the heart of a large city can

prevent changes in the price that may be offered for his lot. The unearned increment that may be enjoyed is of the same nature from an economic standpoint, and is no more blameworthy in one case than in the other. In both cases, the conditions were created or allowed by the public, and property rights and obligations were thereby established which should not in justice and in equity be invalidated or destroyed when changes in these conditions are found necessary to conform to the ever changing demands of progressive thought and action. Individuals should not be made to suffer from the social errors of the past and the penalties of adjustment should be borne by all in just proportion.

Let us never again try to force the whole burden of our errors and imperfections even upon those who have most profited by them in the past, and thus may we avoid such lamentable and appalling conflicts as divided our fair land just fifty years ago.

That the principles involved in those conclusions are becoming recognized by the courts is shown by the following citations:

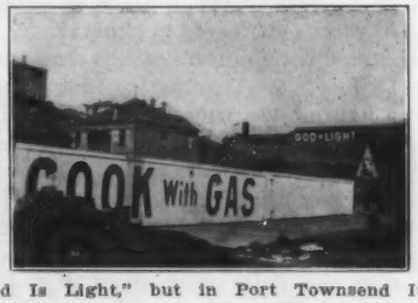
15 I. C. R. R. 376, 415, by Commisioner Prouty, "During all this period the excess has gone into the property, which has gradually become more valuable, and this increased value has reflected itself in the market price of the securities of that company."

179 Po. 231, 46 Atl. 249, 251, by Judge Williams, "In determining the amount of the investment by the stockholders, it can make no difference that money earned by the corporation, and in a position to be distributed by a dividend among its stockholders, was used to pay for improvements and stock issued in lieu of cash to the stockholders."

212 U. S. 414, 29 Sup. Ct. 357, 53 L ed. 577, by Justice Peckham, "It certainly was not proper for the complainant to take the money, or any portion of it, which it received as a result of the rates under which it was operating, and so to use it, or any part of it as to permit the company to add it to its capital account upon which it was paying dividends to shareholders."

COMPETITION.

The accompanying illustration shows the unique condition of affairs at Port Townsend, Wash., where the Key City Light & Power Company operate both the electric and gas plants. In accordance with their progressive policy, they have placed large billboard



"God Is Light," but in Port Townsend It Is Recommended to "Cook With Gas."

advertisements "Cook With Gas" throughout the town. One of these happens to adjoin a small mission church which advertises "God Is Light." The conjunction of the two signs elicits much jocular comment from strangers. We are indebted to Mr. J. A. Kinkaid, manager of the company, for the photograph from which this illustration was made.

SAN FRANCISCO ELECTRICAL DEVELOPMENT LEAGUE.

The first meeting of the new year of the Electrical Development League was held January 14, President T. E. Bibbins, presiding.

After the transaction of the usual routine business, the League adopted the report of the code committee, appointed to confer with the department of electricity with reference to the proposed amendment of the building laws regulating the installation and maintenance of wires and cables used for the carriage of electricity for light and power. The amended rules will provide for the use of metal moulding or armored cable in electrical installations.

The time limit in which the proposed ordinance shall take effect was extended from 100 to 180 days. The meeting adopted the suggestion of Mr. E. B. Strong, western transportation manager of the National Electric Light Association, to organize and operate a special train to Chicago in June next, to be known as the "Golden Poppy Special" which shall convey the California delegation to the N. E. L. A. in that city, at that time.

The speaker of the day, Mr. J. R. Bibbins, resident engineer for Bion J. Arnold, traction engineer of Chicago, was introduced and told of the growth and development of San Francisco and its transportation facilities, the address being illustrated by stereopticon views of San Francisco and other large cities of the country.

The burden of the message delivered to the League was the absolute and pressing necessity for quick and determined action by San Francisco in making due preparation for the growth that is to come, by building extensions to its transit lines, by constructing tunnels to develop the immense acreage of attractive but unpopulated residence territory and secure the necessary intercommunication between isolated districts, and by working out a system of finance by means of which the present unsatisfactory relation between the city and its transit systems may be improved. In analyzing the growth and development of other cities as compared with San Francisco, Mr. Bibbins showed plainly that there was not the slightest cause for apprehension for the future, but rather that San Francisco occupies an enviable position among the large cities of the country with respect to the inherent possibilities of development through short-haul and high riding habit of its citizens. This fact, he stated, should make it particularly easy for this city to improve its opportunities and reach a satisfactory and permanent settlement of the perplexing questions now confronting it. The absolute inadequacy of the city's purchasing power for the acquisition or construction of utilities was emphasized, and results from other cities were drawn upon to illustrate the immediate response of underlying property values to improved transit facilities.

Mr. Bibbins showed the municipal boundaries as they exist have practically no bearing whatever upon the broad movements of population, but rather that rapid transportation and the geography of the district alone control these movements.

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CONTENTS

Cost Data on Small Electric Pumps 57
By Robert Sibley.
Report of Oregon Conservation Committee 58
Lightning Protection of Transmission Lines 59
By Alfred Still.
U. S. Forester's Report on Water Powers 61
Classes of Weirs 62
By B. A. Etcheverry.
San Francisco's Predicted Transit Growth 63
Possibility of Mine Explosions From Incandescent Lamps ... 64
By H. H. Clark.
Irrigation the Gravity Way 65
By R. B. Mateer.
The Significance of Debt-Paying Methods of Public Service Corporations 66
Competition 67
San Francisco Electrical Development League 67
Editorials 68
Electric Pumping Costs.
The Los Angeles Aqueduct Power Problem.
Water Power of Navigable Streams.
Personals 70
Meeting Notices 70
Trade Notes 71
New Catalogues 71
Municipal Inspection 72
By Howard Joslyn.
Costs and Efficiency 74
By D. L. Proctor.
Will Raise Voltage 75
Correction 75
Industrial 76
Type "S" Bell Ringing Transformer.
Recent Power Installation.
Automobile Electric Vulcanizer.
News Notes 77

Electric Pumping Costs

Much discussion has appeared of late in the columns of the Journal relative to electrical pumping and irrigation. To the farmer, having under consideration the purchasing of a complete pumping installation, definite information as to costs is most essential. It is unfortunate that to date the farmer has often been mislead or misinformed on this vital feature with the result that he often finds himself embarrassed with bills totaling double the original supposed outlay necessary. Such, for instance, proved to be the case in the successful installation detailed in the leading article of this issue.

The dealer is not always wholly to blame in all such cases, for the farmer's ideas of plant size usually grow in magnitude as the calling for bids proceeds. It is seen that the additional costs of excavation, concreting, roofing and the like practically totals an amount equal to the dealers' figures for plant equipment and installation. Thus, on first sight, an installation of machinery costing $600 would hardly be thought to ultimately total $1200. Dealers should be careful, now that complete costs are known more definitely than formerly, to see to it that the purchaser is fully aware of the ultimate magnitude to which such installations will total.

Ths electrical pumping of water, though at present of vast proportions, is yet but an infant compared to its ultimate possibilities. Installations of to-day, permanently and successfully accomplished without misrepresentation, mean tremendous activities on the morrow for the dealer supplying the machinery and the contractor performing the installation.

The Los Angeles Aqueduct Power Problem

The citizens of Los Angeles are at present engaged in a heated discussion as to new bond issues and the proper disposal of the power to be developed in the course of conveying water through the Los Angeles Aqueduct from the Owens River Valley to the San Fernando reservoirs. The problem is one of interest, not alone to the people of Los Angeles and the three great power companies now supplying her needs, but since similar projects are even now being proposed in other great metropolitan districts of the West, it is hence of keen interest to Western engineers in general.

Briefly stated the situation in Los Angeles is about as follows: The Los Angeles aqueduct, constructed to date at a figure approximating $25,000,000, is capable of supplying sufficient water to develop at present about 35,000 electrical horsepower. By the chance happening of a rather remarkable series of natural reservoir sites along the line of the aqueduct as constructed, the water may be so controlled during the daily fluctuating period that the peak load conditions now prevailing in Los Angeles may be conveniently handled without auxiliary steam supply. This truly is unusual and gives the aqueduct development a distinct advantage over the companies now operating in that field.

It is proposed by the engineers of the aqueduct to retail this power in and about Los Angeles. By paralleling the present distributing systems, it is assumed that the present load of competing companies

may, at the wink of an eye, be shifted to the city's bus bars. Meanwhile, the power companies now serving the field have made a cold cash offer of $1,000,000 per annum as a wholesale purchase price for the 35,000 horsepower. Any additional power which may be developed along the aqueduct is to have its proportionate wholesale selling valuation. In accepting this offer the city of Los Angeles is not asked to give up its ambition of some day owning its utilities.

To the onlooker removed from the heated field of debate it is surprising that those having the best interests of the aqueduct at heart do not welcome this happy and timely solution of aqueduct expenses, for such an income as this is easily seen to be of sufficient proportions to approximately carry the interest on the present outlay of $25,000,000. On the other hand, the costly competition, the unrelenting and unkindly warfare against hitherto much welcomed servants of the people, the absolutely indeterminate costs of such a struggle and the ultimate re-duplicating of costly service equipment stand forth as ghastly ghosts which may perchance blight a project now receiving hearty commendation and support from engineering quarters the world over.

It would seem that the promoters of the Los Angeles aqueduct would content themselves for a season at least, in consummating the main object of their great municipal undertaking, perfecting the general scheme of operation, rather than whetting the battle axe for an immediate fray, when such a fiasco may reasonably be avoided.

Considered again from its economic side, which after all should be the fundamental basis of argument, the citizens of Los Angeles should themselves prevent reduplication of a costly distribution net-work. The surprising sight, which greets the engineering visitor, when inspecting for the first time the distribution system in Los Angeles, is the comparatively small amount of reduplication work which the present competing companies have themselves suffered to take place. In countless districts casual investigation shows that a competing company has not entered a field properly and adequately served by its rival. In those districts where competing lines have been instituted the remarkably efficient and economic system of combination poles impress the visitor that careful curtailing of expenses involved has always been kept in sight. Indeed this joint pole system, instituted only a few months back, has saved by its neat and unobtrusive workmanship much costly underground work which otherwise would have been a necessity. The fact that a saving of 35,000 poles in distribution has been effected is indeed a positive indication of this foresight.

To reduplicate equipment means a burden of $6,500,000 to be borne eternally by the citizens of Los Angeles. The saving in interest on this sum which will be accomplished by wholesaling means an additional annual expenditure of over $300,000 otherwise necessitated. The utility companies of Los Angeles are securely controlled by regulating commissions. No possible unjust charge can be made by them in retailing this power. As distributing agents acting under tightly bound regulating commissions controlled by its citizens, the utilities of Los Angeles can charge only what is just and reasonable. Putting aside countless arguments which may be presented in allowing the present servants of the people to continue to distribute their product under wise regulation, the fundamental law of economic operation—avoidance of costly reduplication—demands that the conservative two-thirds of the voters in Los Angeles try, for a season at least, the proposed scheme of wholesaling the aqueduct power.

Credit, the basis of the phenomenal growth of Los Angeles, is at stake. Her utility securities are now known the world over. Whether to jeopardize this credit should indeed be thoughtful food for the reflection of her citizens.

Water Power of Navigable Streams

Again the problem of water power grants confronts the nation. The world's greatest development at Keokuk, Iowa, wherein 300,000 horsepower are to be brought to life in the near future by the raising of the Mississippi River, is illustrative of the countless possibilities of the great Columbia and other powerful streams of the West. Hitherto Western engineers have sought comparatively high heads for the generation of hydroelectric power. The great slow falling rivers have been correspondingly neglected. Recent advance in low head power generating apparatus now makes possible the utilization of a drop through the turbine, formerly considered thoroughly impracticable.

The cry of the West is "Make ready the way for the coming of 1915." Improvement of Western national waterways is especially an emphatic necessity. In his recent message to congress the President has forcefully called the attention of that body to the need for immediate necessity of improving the methods in grants for water power development on navigable streams. The development of power and transportation intercourse must go hand in hand. The uses of the one are impossible without the other. That a portion of the income from power utilization may be made to pay for a reasonable improvement on the stream itself looking toward increasing navigation facilities on that stream is truly far-sighted statesmanship.

Indeed the construction of these dams of themselves materially aids in this great work. Most of the navigable rivers of the West are comparatively long and shallow. The slack-water or canalization method used in river navigation improvement has of late been proposed by many experts as being thoroughly sound. This method consists in building a series of dams and locks, each of which will create a long pool of deep navigable water. At each of these dams there is usually created also water power of commercial use. Such a chain of developments would certainly ultimate in the highest economic utilization of the rivers for power and navigation. Any enactment charging for the privilege of power generation of this sort, by private corporations or municipal undertakings, should specifically provide that no discrimination be made as to privately owned corporations versus the municipally owned. Furthermore, all moneys thus accruing should be put back into improving the uses of the particular waters whence comes this natural resource.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Thomas Mirk, of Hunt, Mirk & Company, has returned to San Francisco from Southern California.

Harry Hays came up to San Francisco from Visalia and attended the Electrical Development League meeting Tuesday last.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, is visiting Portland and Seattle.

James H. Mason, general manager of the Simplex Electrical Company, Boston, has left for an extended trip around the world.

J. R. McKee, A. D. Young and **Anson W. Burchard**, of New York, have been elected vice-presidents of the General Electric Company.

R. B. Mateer, representative of the Great Western Power Company at Sacramento, spent several days in San Francisco the first part of the week.

C. P. Rhodin, civil engineer with J. G. White & Company, is at Paisley, Ore., in connection with some reclamation work of which his company has charge.

J. B. Lukes, representative of the Stone & Webster Engineering Corporation, is expected to return to San Francisco from the East about January 25th.

E. M. Cutting, who has recently taken the Pacific Coast agency for the Edison Storage Battery Company, has established officers at 818 Mission street, San Francisco.

R. M. Alvord, manager of the supply department of the General Electric Company at San Francisco, has returned to his office after a two weeks' absence in Central California.

E. K. Barnum, who has been in charge of the construction of the Nisqually power plant of the City of Tacoma, has been appointed superintendent in charge of operation by **Nicholas Lawson**, commissioner of light and water.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, was at Los Angeles during the past week. A surveying party is now at work on the new Tule River development of the San Joaquin Light & Power Corporation.

Heinrich Homberger, consulting engineer, San Francisco, has been appointed advisory engineer for hydraulic plant equipment by the Oro Electritc Corporation in connection with the proposed 40,000 k.v.a. power plant on the north fork of the Feather River, California.

H. W. Soderling has resigned as manager of the Wenatchee Valley Gas & Electric Company to become vice-president and sales manager of the Bliss Electric Company, at Wenatchee, Wash. His successor is **Louis Shreve**, formerly assistant manager.

M. L. Scobey, of the Pacific States Electric Company, was married to Miss Sue Agnew January 15. The newly-weds have left San Francisco on a week's honeymoon trip. Congratulations to Mr. and Mrs. Scobey, and may the future have many years full of happiness and contentment in store for you.

R. H. Dearborn, professor of electrical engineering at the University of Oregon, at Eugene, has been appointed consulting electrical engineer to the Railroad Commission for the State of Oregon. This commission's powers have been increased to include supervision of all public utilities in the state.

F. W. Hild, general manager of the Portland Railway, Light and Power Company, returned from Los Angeles to San Francisco this week, and will return to Portland on Sunday While at Los Angeles he addressed the Electrical League.

E. G. Allen, superintendent of construction Stone & Webster Engineering Corporation, Seattle, Wash.; **Wm. J. Davis, Jr.**, engineer Pacific Coast district General Electric Company, San Francisco, Cal., and **H. Y. Hall**, assistant electrical engineer Southern Pacific Company, San Francisco, Cal., have been transferred to the grade of member in the American Institute of Electrical Engineers.

A. H. Babcock, electrical engineer for the Harriman Lines, San Francisco; **O. B. Coldwell**, general superintendent of the Portland Railway, Light & Power Company, Portland, Oregon; **R. F. Hayward**, chief engineer and general manager of the Western Canada Power Company, Ltd., Vancouver, B. C.; **C. W. Koiner**, general manager and electrical engineer Pasadena (Cal.) Municipal Light Department; **F. D. Nims**, electrical engineer Western Canada Power Company, Vancouver, B. C., and **J. D. Ross**, superintendent of lighting, Seattle, Wash., have been transferred to the grade of Fellow in the American Institute of Electrical Engineers.

MEETING NOTICES.

Idaho Society of Engineers.

The Idaho Society of Engineers will hold its annual convention at Weiser, February 20, 21, 22 and 23. Subjects of papers and discussion will be Pumping for Irrigation, and Road Construction. On the last day mentioned an excursion will be taken down the Snake River to Homestead, Oregon, giving the engineers an opportunity to visit the gypsum plant, below Huntington, the Oxbow tunnel and power plant, near Homestead, and several mines in that vicinity. It is estimated that over 100 members will attend. The officers are: D. G. Martin, Idaho Falls, president; A. E. Robinson, state engineer, Boise, vice-president; Edward Hedden, Caldwell, treasurer; Ira Shaffner, Boise, secretary.

Spokane Jovians.

C. R. Bean, Jovian statesman for Washington, advises that Jovian lunches were held at Spokane on December 10 and 24th.

The luncheon on the 10th was presided over by V. G. Shinkle, purchasing agent for the Washington Water Power Company. Mr. Loomis, illuminating engineer of the H. W. Johns-Manville Company, gave an instructive talk on illumination, illustrating his remarks by means of various shades and various lights. Mr. Wilson, oil engineer for the Galena Signal Oil Company described the matter of lubrication as applied to electric railway rolling stock and hydro-electric generating stations. The luncheon on December 24th was presided over by H. G. Peterson, and talks were given by Fred Caldwell, chief engineer of the Independent Telephone interests in Eastern Washington, Montana and Idaho, and by Mr. Loebell, commercial engineer of the Spokane Falls Gas Light Company. Mr. Caldwell's talk was on the automatic telephone system, going into the construction, operation and maintenance of the modern commercial telephone. Mr. Loebell described the manufacture and marketing of gas, and also new apparatus which will be put on the market this year. The interest in the luncheons seems to be increasing, as over forty were in attendance. On January 14th, Mr. Bean will preside. The policies of the Jovian Luncheon Club for 1913 will be discussed.

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held at the clubrooms of the Oregon Technical Clubrooms, 247½ Stark street, Portland, Oregon, at 8 P. M. January 21, 1913. The paper of the evening will be presented by Professor W. A. Hillebrand, professor of electrical engineering, State Agricultural College, Corvallis, Oregon, the subject being "Transformer Connections."

Portland Jovians.

The "Jovian Electrical League" luncheon took place as usual at the Hazelwood at noon, the 9th, about forty being present. J. B. Middleton of the Home Telephone Company, gave a brief talk, outlining the ideals of the Home Company. He said his company welcomed state regulation, as it protected them against the Bell interests in many cases where they could not protect themselves unless they had a commission to appeal to.

Mr. Burnett Goodwin is chairman for the month of January.

A "Publicity Secretary" was elected, the honor falling upon Mr. "Ole Olson" of the Fobes Electrical Supply Company.

After this date no more postal card notices will be sent out, but it is to be understood that the Jovian Electrical League luncheon is a permanent affair, and will be held at noon every Thursday at the Hazelwood Restaurant. Speakers of general interest will be obtained for every meeting.

Oregon Technical Society.

The first regular Oregon Technical Club luncheon of the new year was held at the so-called offices of the commission, Portland Hotel Rathskeller, on Tuesday, January 7th, at 12 noon. All members of the Oregon Society of Engineers, Portland Architectural Club, American Institute of Architects, American Society of Civil Engineers, American Institute of Electrical Engineers, National Electric Light Association, American Society Mechanical Engineers, were called upon to attend this session of the commission, when bids were opened on the "Sullivan's Gulch Canal Project." Estimated cost of this work, $37,000,000. Several fake contracting corporations were on hand to submit bids, and for a "stunt" luncheon it was one of the best ever enjoyed here.

Subsequent luncheons will be held as follows, under the auspices of societies mentioned: January 14th, A. I. E. E.; January 21st, Portland Architect Club; January 28th, M. E. L. A.

TRADE NOTES.

The Boston office of The Cutler-Hammer Manufacturing Company moved from 176 Federal street to larger quarters in the new Columbian Life building the first of the new year.

The firm of Otis & Squires of San Francisco has been dissolved. H. B. Squires will continue the business as H. B. Squires Company. W. I. Otis will be identified with several Eastern manufactures.

The Simplex Electric Heating Company has added a four-story addition to its factory at Cambridge, Mass. It is planned this increase of space will merely allow expansion of the congested quarters to a comfortable working condition, and does not provide for expansion necessary to take care of further normal growth of the concern's business.

The Oakland, Antioch & Eastern Railway Company of San Francisco, has ordered from the Westinghouse Electric & Manufacturing Company one quadruple equipment of No. 308B-6 and Type HL Control for use on an electric locomotive. This is a duplicate locomotive ordered by this company several months ago which is now in operation. The locomotive is designed for operation on either 600 or 1200 volts direct current. The Santa Barbara Consolidated Railway Company, Santa Barbara, Cal., has ordered ten double equipments of No. 337-C-3 motors and RLF control.

The Greenwood Advertising Company, the largest manufacturers of individual electric signs in this country, has recently determined on the establishment of a factory in California. The plant will be located at Los Angeles and it is expected to have same in operation by the first of February. The home concern is located at Knoxville, Tenn. Both factories will have the same management and inspection by the National Board of Fire Underwriters and Label System. Mr. A. Greenwood is president of the company and Mr. J. E. Zucker, vice-president and general manager, with offices at 211 Blanchard Building, Los Angeles.

NEW CATALOGUES.

Bulletin No. 2 from the Automatic Flagman Company of Los Angeles, Cal., attractively portrays the manner in which their signal protects grade crossings on steam and electric railways, giving combined visual and audible warning for both night and day operation.

The Engineering Department of the National Electric Association has recently issued Bulletins 8D and 10c. The power is devoted to Mazda miniature and low voltage lamps, including lamps for automobile, general battery, novelty battery and similar uses. The latter is concerned with Mazda train-lighting lamps, showing the performance and characteristics of lamps designed for steam railway use.

Westinghouse Box Frame Commutating Pole Railway Motors Nos. 317, 317-A, and 317-A2 are thoroughly described and illustrated in descriptive leaflet No. 3511, recently issued by the Westinghouse Electric & Manufacturing Company. Folder 4245 covers the Westinghouse Universal Blow Torch, which is adapted to all conditions of service. A cross-section view of the torch illustrates its working parts, and the little folder describes the mechanism in detail. "Saving the Tires Without Fire" is the title of a little folder describing the automatic tire vulcanizer manufactured by this company. Particular emphasis is laid on the fact that no fire is required, and therefore tires can be vulcanized in the garage without any danger.

The General Electric has recently issued Bulletin No. A4065, describing its various types of Polyphase Induction Motor Motors. Bulletin No. A4069 is devoted to the subject of Portable and Stationary Air Compressor Sets. Bulletin No. A4066 illustrates Electric Hardening Furnace. Bulletin No. 4994 describes and illustrates Subway Transformers. These supersede previous bulletins on this subject. Bulletin A4065, the 1913 Catalogue of Electric Fans, is an attractive publication of 36 pages, in colors, and it illustrates fixed and oscillating desk and bracket fans for alternating and direct current, and also ceiling fans and ventilating fans. The publication contains also illustrations of various wiring devices for use in connection with fans as well as a list of supply parts for all fans.

BOOK REVIEW.

"The Distribution of Gas." By Walter Hole. 837 pp., 5½x8½ in.; leather bound. Published by John Allan & Co., London, and for sale by Technical Book Shop, San Francisco. Price $5.00.

The appearance of a third edition of this treatise in less than six years is conclusive proof of its value as a text-book for the student and a hand-book for the manager. The text is divided into thirty-seven chapters, dealing with every phase of the subject. The new edition has been thoroughly revised and many additions made to care for recent developments in illumination, heating and combustion. The library of every gas man is incomplete without this volume.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

MUNICIPAL INSPECTION.[1]

BY HOWARD JOSLYN.[2]

Municipal inspection of sanitary and structural work done by individuals with the object of protection to life and property, has grown largely in the past decade. As towns and villages grow to be cities efforts of this kind follow as part of the advanced police powers given to the corporation by its citizens.

Muncipal inspection of buildings and all pertaining thereto is apt to seem over done to those who are effected by the stringency or difference of the regulations over methods to which they have been accustomed. Prejudice of this character may continue for a long time, unless the inspection departments are careful in their dealings with citizens to point out reasons for their work being kept to certain standards.

You have all doubtless seen some of the numerous statements comparing property losses from fire in the United States to those of other countries; apparently much to our discredit. There are undoubtedly causes for this great annual loss which can be remedied to greatly reduce the same; but it must be admitted that conditions of rapid and enlarged construction in this country have some bearing upon the results. Everywhere is manifest the ambition of our people to quicken the pace, to centralize in cities; and following such centralization to erect high buildings and utilize to the utmost a small ground space. Of all the agencies assisting man in the speeding up progress within the past generation, electricity can easily be called the foremost. Its use, however, is not an unmixed blessing; and unless properly conducted for its purpose it may prove an engine of destruction.

Having perceived these conditions the genius of man has endeavored to make plain all things which should be guarded against in the use of this valuable force. Early manifestations of its destructibility as a fire hazard naturally brought it most prominently to the attention of those whose business is chiefly affected thereby; that of insurance. As an outgrowth of much study and effort we have an electrical code providing rules and regulations for the installation of electrical equipment in and about buildings. To ascertain the extent to which their regulations are carried out, those interested in the insurance business naturally have inspectors. All such inspection, however, has been guided by their business rules; and, although it has accomplished great good, yet its extent has not been sufficient.

Realizing all this, cities of the highest class have found the principal method of betterment thereof in establishment of an inspection by the municipal government. It is, however, with great credit to the engineers who made up the electrical code, that municipal regulations for installing electrical equipment follow closely the rules established by the code. Its many rules are really the application of a few broad principles to govern work with a great complexity of details; and criticisms of the code are generally based upon its application to details of some particular work on some one or few specified occasions.

Some municipal ordinances differ slightly from each other and from the code; and considerable discussion of this matter has brought forward advocates of some plan by which the wiring regulations of all cities can be made alike. It is apparent that general action of this character can best be brought about by the Federal Government acting upon broad lines to create standards of construction and materials to be used. Some effort already made in this direction has shown that much time will probably elapse before anythig definite can be accomplished. Meanwhile considerable good is being done by conferences between inspectors, representing different cities, in their association meetings in various parts of the country.

To obtain knowledge of all work done is the first object of the inspection department; and, to this end, practically all city regulations require that a permit must be taken out before beginning the work. The charging of fees for issuing permits or for making wiring inspections is based upon two reasons, either for revenue to meet expense of inspections or as a penalty to command greater attention to the necessity of obtaining a permit for work to be done. The charging of fees for revenue is objected to by many as being a charge upon the individual for the benefit of many; but on the other hand it is argued that the owner of the property wherein the work done is being inspected is the one immediately benefiting thereby. Advocates of the fee as in nature of a penalty must also answer the argument that the proper penalty is one to be inflicted after commission of error and not as a notice in advance to refrain from it.

The city of Seattle has recently passed an ordinance abolishing all fees for wiring inspection to take effect January 1, 1913. The amount of fees collected there since beginning the work in July of 1910 has been sufficient to more than meet the expenses of the inspection work by about ten per cent. It is feared by some that without revenue from fees efforts made by subsequent administrations to reduce expenses may result in cutting down the number of inspectors below that actually required for the work; but this is still a matter of conjecture.

After the permit is issued, it is distinctly the duty of the contractor or wireman doing the work to report same to the inspector when ready for inspection. Neglect on his part to do this promptly may not only cause much embarrassment to the owner but also annoy the inspection department through its receiving undeserved criticism as being the source of troubles arising therefrom. City ordinances should properly give to the inspector the right to remove obstruction, such as lath and plaster, in order to view the work; and while the giving of notice of preparedness for inspection rests with the wireman yet there should also be some remedy for prevention of undue delay upon part of inspector after receiving such notice. Corrections found by the inspector should not only be left in a statement at the work, but should be sent by mail or otherwise to the wireman; who in turn should proceed promptly to make the required changes and again call it up for inspection. The observance of these principles of action on the part of both contractors and inspectors marks a long step forward in the line of successful municipal inspection.

The past decade has witnessed rapid advancement in construction and material for installing electrical equipment. At first wiring was done as open work, then in concealed knob and tube work and in wooden moulding, to be followed by the use of rigid and flexible metal conduit with accompanying refinements of materials and more economic methods of construction. The natural desire of all owners to save money is not often modified with an ambition to secure the best and most durable installation. Keen competition between contractors and wireman for work generally results in their suggestion of economies in cost; all of which try to lessen the standards of work recommended by the inspection department. To reduce the possibility of misunderstanding it is the best policy to define the city regulations within what districts or in what classes of building certain methods of installation must be used. Some cities now require all wiring to be in-

[1]Paper presented at Annual Convention Oregon Electrical Contractors' Association, Portland, December 17, 1912.

[2]City Electrical Inspector, Seattle, Wash.

stalled in metal conduit; some require metal covering altogether in certain specified districts; some require it in structures other than of wood; and the general tendency is to eliminate altogether the use of wooden moulding and greatly reduce the extent to which open work may be applied; concealed knob and tube work being best adapted to residences.

Seattle requires that wiring in practically all buildings other than of wood and in all buildings for storage and warehouse purposes shall be encased in metal conduit or moulding; also that all cabinet boxes shall be of metal; and all services installed in conduit. Parallel with these regulations is the one now very general, that all conduit or metal moulding should be carefully and effectually grounded, the exception to which requirement should only be allowed by the inspector in cases of very short pieces of conduit which do not come into contact with combustible material or are not in a location where liable to contact with persons. Another regulation for general safety should preclude the installation of current carrying equipment within reasonable reach of grounded contact, such as the installation of metal sockets or switches close to bath tubs, lavoratories, etc.

The Underwriter's Laboratories at Chicago, with their thorough tests of wire insulation and other electrical equipment in accordance with the construction rules of the National Code, have been almost universally adopted as a standard of reference for electrical material and appliances acceptable to municipal inspection departments. With no desire to criticise their admirable work, yet with a desire to improve local conditions, one or two cities are conducting their own tests of electrical equipment used within their municipal limits. Unless a central testing laboratory is so established that its decisions will be taken by the courts when such decisions are established as binding by city ordinance it is highly probable that an action in law contesting the same, brought by a capable attorney, would result in decisions adverse to the inspector.

Another consideration presents itself in the difficulty for distant cities to obtain prompt knowledge of appliances accepted by the Underwriter's Laboratories; and for the inspector to be positive that its distinguishing marks of approval are authentic. Until present conditions are changed, it therefor seems advisable that municipal inspection departments on the Pacific Coast, and in other places distant from Chicago, should be equipped for determining whether or not electrical appliances and material comply with the construction rules of their ordinances. As a beginning of such work it would be well to at least equip the departments for testing insulation of various kinds of wire. Simple tests by measurement and otherwise can also be conducted for determining qualifications of other material and appliances.

One question which has arisen since passage of the amendments shown in the 1911 edition of the Code is in regard to the stretching tests to be given rubber insulation of wire several months after its receipt from the factory. It is claimed by some that the stretching test for new wire should not be applied to rubber-insulation when it is several months old but yet has not been in service. The plea is made that for such rubber insulation the lower stretching test of 4 and 5 inches should be used. The latter argument, however, is not good because of the indeterminate factor of age of insulation, to be sure of which the inspector must have absolute knowledge of the wire from its time of manufacture until it is put into service. This would involve much additional work for inspection departments, reaching beyond geographic limits of their jurisdiction; and the general plan has been to require that rubber insulation of all wire used must meet the stretching test specified for new wire. The lower stretching test should be regarded as applicable for determining quality of insulation upon re-survey after the wire has been in service for a period not exceeding one year.

The rules for general wiring of the several classes are doubtless too well known to require discussion in detail at this time. Municipal ordinances should express the rules and regulations in a clear and concise manner making their meaning plain and positive. Nothing can create more trouble for the most conscientious chief inspector than a large discretion allowed him under regulations which state that one or more methods may be used subject to his approval. His approval in such instances will undoubtedly, after a time, result in establishing precedents which will conflict thereby causing almost endless confusion. In work with so much detail there cannot but exist one or two points where the inspector's approval is really the basis of the rule; but this should only occur when absolutely necessary.

Much confusion may arise from interpretation of the rule of 660 watts as constituting the load upon a branch circuit. With a desire for economy wiring is often laid out with the view to not only restricting the outlets, but also the number of circuits by specifying one or more 16 c.p. lamps capacity to the outlet. How often it is the case when the architect or wiring contractor's plan is followed that a re-survey several months after the wiring is put into service will find one or more branch circuits over-loaded? This trouble should be promptly met by the chief inspector setting a reasonable limit upon the number of outlets per circuit and preferably requiring a diagram of the work to be submitted in advance. The general rule in Seattle is to establish 8 outlets as a maximum for branch circuits in residences, and 6 outlets for branch circuits in business houses. All of this, however, is subject to change after inspection of plans or diagrams of the wiring which are required to be filed with a large portion of the applications made.

Determining the capacity of main and sub-feed wires should be done by the inspector on the basis of branch circuits with consideration of the average load. The public service corporation furnishing light and power will generally place the size of its service mains at far less than could possibly be considered for main feeds by the inspection department. They do this for economic business considerations which are foreign to the fundamental idea of the large factor of safety upon which inspection regulations are founded. It is the duty of the inspector, however, to base his estimates upon a reasonably safe amount of average load; and the sizes of wires demanded to reduce the voltage drop to two volts will not often be lower than the general table of allowable capacity for rubber insulated wires. In residences, hotels, office buildings and apartment houses 75 per cent of the amount obtained by multiplying the number of branch circuits by six amperes should afford ample safety in fixing capacity for main and sub-feeds. In stores, theatres, churches and places of public gatherings the percentage should be one hundred or very close thereto.

It is universally recognized that the carrying capacity of rubber insulated wires is safely more than that established by the table in the code and in general use by inspection departments. The standard of inspection set by some municipal departments is such that the allowance of larger capacities would be safe but wisdom would not be shown in making this change generally because of the lack of comprehensive and authoritative inspection by many towns and cities. Any further steps of this kind will be largely brought about only by the betterment and increase of municipal inspection. One change, however, which might be allowed is the increase in size of fuses to ten amperes for branch circuits. This size of fuse is generally used in replacement after the work has been approved by the inspector; and it is well within the safe capacity of No. 14 gauge wire.

Municipal inspection departments should be given full authority over all electrical appliances installed and used in theatres and places of public gathering; and such supervision should extend over the persons employed to care for and use such equipment. Motion picture operators should be carefully explained and their work allowed by suitable license revocable on their failure to carry out regulations of the depart-

ment. A conscientious inspection of the same will then almost eliminate accidents or losses due to electrical hazard.

The field inspector shoudl have as one qualification a comprehensive experience as a wireman in various grades of the work. Without going into detailed instruction for benefit of some amateur workman, the inspector's practical knowledge is often of greatest importance in discussion of details with the contractor. There are very few lines of work possessing such a variety of detail, and many cases arise wherein the regulations must be interpreted in the light of common sense and practical experience. Few inspectors have not met with the old contractor or wireman of long experience who did work before the code was established, and who really in his own opinion knows more than the man who wrote the rules. Should such wireman be of an obstinate disposition, heated discussions will frequently arise between him and the inspector. This is one instance where the municipal ordinances, if properly drawn, are far superior to the code when used as a reference by inspectors, either insurance or muncipal. Field inspectors should never be permitted to indulge in a heated or forcible argument with the contractor or workman upon the job. The inspector should simply state that he is there to look the work over and all arguments should be taken up with the head of the department. When such cases are brought to the attention of the chief inspector, if he has the right kind of an ordinance, he can politely but firmly show the futility of questioning the established regulations, stating that changes therein can only be made by legislative authority.

Criticism is sometimes made by contractors that the field inspector has made unfavorable comment to his customer about the work. Some instances of this kind may have been true, but it will generally be found, with a sensible man as inspector, that the statements attributed to him have been largely put into his mouth from the thoughts of the customer. Some people will probably always be found who will endeavor to "beat the game"; and they are not over scrupulous even in so small a matter as "standing off" the contractor or wireman for his pay on account of alleged faults or inspectors' statements which have really not been made. It is generally not the inspector's duty to state that a fixture is hung too low, or that the shades are not of the correct size, or that the finish of the wiring cabinet is not in harmony with the style of furniture, etc. Criticisms of this character are apt to justly detract from the standing of the inspection department which can in such instances reasonably be told to mind its own business. The training of field inspectors should cover all matters of this kind with the object of obtaining capable and common sense supervision of the work done.

With the advancement of the application of electricity, there is another action toward guarding the interests of the owner or customer which has not, as yet, been widely taken; viz: that of safeguarding the people against the misrepresentations and sometimes rascality of irresponsible wireman and socalled contractors. Ordinances should be passed by cities and, if necessary, laws by the state legislature fixing an examination for all wiremen by which they may obtain a license to do work; all of which may or may not be accompanied by a responsible bond. Many property owners have been persuaded by cheap prices to let the wiring contract to a workman who, after collecting as much money as he can on the work, will run away and leave it far from a condition in which it would pass inspection. The added burden upon the owner in such cases often bring the cost of the work to a greater sum than if the work had been done by a responsible contractor. The remedy for these conditions is not hard to obtain by intelligent and concerted action on part of the responsible wiremen; and when once put into force it will go far to elevate the trade and secure to it the respect which it deserves.

COSTS AND EFFICIENCY.

BY P. L. PROCTOR.
(Concluded.)

Floor No. 1.

Wire plus time, plus direct expense, plus indirect expense, equals cost of wiring Floor No. 1.

Pipe plus time, plus direct expense, plus indirect expense, equals cost of piping Floor No. 1.

It will be readily seen that were estimates to be kept on file in this detailed manner, and the cost records kept to conform to it, the executive would soon locate his weak points in making estimates, and by careful examination of each day's work he would readily see whether or not the estimate in any particular unit and the profits anticipated on it were going to be realized. You will readily agree with me, I think, that such information is invaluable, for it gives a reliable basis of argument, should the contractor find it necessary to urge his men to "speed up" in order to break even on any particular unit of the work.

The distribution of indirect expense or burden has become the subject of much discussion and debate by many cost experts. Many theories have been advanced from time to time by some of our leading production engineers and cost accountants, as to the distribution of indirect expense, but it is as much open to discussion at the present time as it ever was.

At this time we are only interested in the method that best fits the requirements of the contractor, and after much thought I have come to the conclusion that the distribution of burden by the time plan is the one that is more adaptable to his needs. A summarized explanation of this method is that every productive man in the employ of a company must bear his pro rata of indirect expense of that company. We will take an hypothetical instance.

You are called upon to make an estimate of a job. Your overhead expense or burden amounts to $12 per day; there are 12 productive men in your employ, therefore each man will bear $1 overhead expense per day.

Your estimate will read as follows:

Material	$25.00
Time (1 man 1½ days at $4.00 per day)	6.00
Overhead expense (1 man $1.00 per day—1½ days)	1.50
Cost of production	32.50
Profit 25 per cent	8.12
Amount of estimate	40.62

You will see that by this method the overhead expense practically adjusts itself automatically to a fair amount per productive man. A large increase in productive men generally means a proportionate increase in unproductive men, and, on the other hand, a reduction in the productive force means a proportionate reduction in the unproductive force. At the same time there are certain fixed charges that a reduction in the productive force would not affect, such as rent, light, heat, office expense, etc., and in this case the executive must use due discretion, and must, by careful examination, ascertain where he can reduce his overhead cost so as to bring it down to a standard whereby he can render satisfactory estimates, and still assure himself of profit.

A cost system which comprises the information I have just referred to is the first step toward efficient management.

To build up a successful business one must not only know the trade or profession in which he has started, but he must be prepared to meet his competitors and start on a level which it has taken them years to attain. In order to do this he must not only familiarize himself with the principles of costs, but he must, each day, watch his business with an eye which has keen analytic powers. Clinton E. Woods of New York City, who is considered one of the ablest practitioners of costs, says that a business is a living, breathing, moving being, which has an anatomy peculiar to itself, but which can nevertheless be analyzed in its every func-

tion. It is the duty of a manager of any business to grasp and interpret his business conditions by units. I am sorry to say that book keeping is only tolerated by many business men. It is charged up as a loss, and the expression, "If I could only cut down my office force," crude as it may seem to many of us, is by no means uncommon. This class reminds me of an Egyptian mummy. A mummy's only asset is its age, and the only emotion it inspires is one of wonderment that it has lasted. Three-fourths of the business failures are mummified businesses. If they had been galvanized into new life before it was too late, they would be still doing business on a sound basis.

I have remarked that account keeping was only tolerated and I will venture to say that half of the business men in this country do not use their records enough to become acquainted with the invaluable information they possess. Account keeping for precedence sake is worse than no account keeping, for the man who keeps no accounts obtains the same information, which is nil, as the man who keeps accounts for precedence sake, and at less cost. If you are going to keep accounts and are employing an office force to keep them for you, do not let this department become a loss to your business. If it be used in the manner for which it was intended, namely, to give reliable facts of business transactions, it would become one of the most profitable departments in your organization.

Another principle which is absorbing the minds of our eminent business men is the relationship which should exist between employer and employee. A contractor's profits rests in the efficiency of his workmen, therefore it should be the employer's foremost thought. There is a lot of unnecessary dignity which is impressed upon the mind of the employe by the employer. This has an unwholesome tendency to widen a breach which is already dangerous between these two classes. Capital makes labor and labor makes capital, therefore the two existing because of this relationship should be brought together in practical harmony. An employer should learn to understand his men and acquaint himself with their efficiencies and inefficiencies. Hiring and firing are indiscriminately practiced without study and discretion. All business men have different ideas of conducting their business and when an employe has been in one man's service a little while he becomes a capital investment and not as a movable commodity. There are many ways by which an employe can be interested not only in the work which he is employed to do, but in the company at large, for it is the organization which has the co-operation of all its employes that, undisturbed by turbulent feelings of its workers which in so many cases is the ruin of many, forges steadily ahead and pays dividends on an inexpensive investment of courtesy.

In closing, I would urge the electrical contractors of this country to follow the example of the printers by appointing a cost committee to draft up a cost system, which will be applicable to your needs, and which can be cut down or elaborated on to suit the business of every contractor, be it large or small.

WILL RAISE VOLTAGE.

The British Columbia Electric Railway Company is contemplating the alteration of its transmission system on the lower mainland of British Columbia and the provision of an improved central service covering its large territory in that section. At present the company's transmission lines, carrying 40,000 volts, run from the generating station on the North Arm of Burrard Inlet to substations at Burnaby and Vancouver, at which points the current is stepped down and distributed. The company's new plans as tentatively announced contemplate the erection of a large receiving station near Esmond avenue, Burnaby, along the route of the Burnaby interurban line. Current will be sent to this station from the North Arm power house at 60,000 volts and connections established from the central point with the various substations, a loop system being formed so that alternate sources of power will be available at each point in case of accident to any part of the lines. The plant of the company, while not complete as to detail, are said to involve the reconstruction of the present pole lines from Lake Buntzen, equipping the line with 60-foot poles carrying metal cross arms and disc insulators of the suspended type.

CORRECTION.

The latter part of "Exhibit F" in F. D. Weber's paper on "The Relation of the Oregon Electrical Contractor to the Underwriters' Inspection Work in Oregon" as published in this journal on December 14, 1912, was omitted. In order to make this report complete the following data should be added:

Index of Deficiencies.

10. Attics not properly bored and bushed.
34. Service conduit must extend to main line cutout or into cabinet if same is required.
50. Flexible cord not standard.
51. Flexible cords too long (a) or used other than as pendants.
52. Flexible cords in show windows.
55. Portable lamps, motors, fans or fixtures not connected through reinforced cord.
58. Pendant cord attached to circuits without approved fittings.
59. Unapproved cord adjusters.
60. Cord circuits.
63. Pendant cord used for outside wiring not approved.
101. Wires attached with wood cleats, staples or nails.
131. Loose fittings.
172. Service wire bushed with flexible tubing; must be porcelain or conduit.
211. Fixture canopies on top of circuit wires or pendant switch wires.
230. Installation in such a hazardous condition that same should be completely re-wired.
272. Miniature light wiring not approved.
360. Lamp receptacles with exposed lugs or contacts in show window.
392. Entrance switch improperly located (a) or not readily accessible.
396. No sub-base under snap switch (a) or receptacles.
430. Lamp sockets not bushed.
495. Wires in contact with outside awning (a) or with metal front or side of building.
497. Wires not bushed (a) or bushed improperly through walls, floors or partitions.
498. Wires of opposite polarity through one hole.
500. Wires not attached rigidly in position (a) or loose from support.
503. Wires not supported at sufficiently frequent intervals.
508. Wires in contact with other materials than insulators.
509. Unapproved wire.
515. Bare wire.
516. Wires knobbed (a) or cleated over flat surfaces.

Your "special attention" is called to the defective installations in the following risks, thirty days or more having elapsed since owners were advised:

Party Responsible.	Class.	Street.	Defects.
		West side Main Street.	
W. F. Matlock..823-815	B	Blk. 1, sh. 7, p. 33, r. 12	10, 34, 55, 58. 60, 63, 392, 430, 495, 508, 509, 515, 516.
Tom Malarkey ..749-755	B	Blk. 3, sh. 7, p. 34, r. 2	50, 51, 52, 55, 59, 60, 101, 131, 172, 211, 230, 360, 392, 396, 497, 500, 508, 509.
Chas. Brownfield ...745	B	Blk. 3, sh. 7, p. 34, r. 8	52, 172, 500, 508, 516.

Defective installations were found to exist in the following risks, and the owners have been advised:

		West side Main Street.	
Jesse Failing ...901-903	D	Blk. 317, sh. 7, p. 33, r. 2	230.
W. F. Matlock ..837-851	B	Blk. 1, sh. 7, p. 33, r. 6	172, 211, 272.
W. F. Matlock ..829-831	B	Blk. 1, sh. 7, p. 33, r. 10	52, 58, 101, 172, 498, 503, 508, 516.

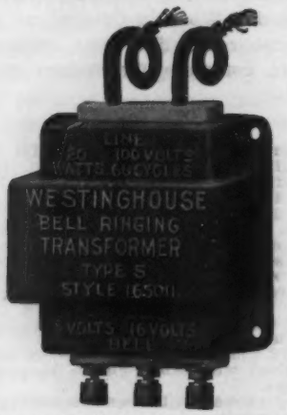
Moving picture machines are improperly installed in the following risks, to which your "special attention" is called:

		West side Main Street.	
Swartz & Greenlick (Pastime) 610	B	Blk. 353, sh. 16, p. 35, r. 10	..Booth not standard.
J. P. Meternock (Orpheum)	—	Blk. 323, sh. 16, p. 35, r. 10	..Booth not standard.

INDUSTRIAL

TYPE S BELL-RINGING TRANSFORMER.

The use of bell-ringing transformers has become so popular that the Westinghouse Electric & Manufacturing Company has placed on the market a new transformer of this type. The fact that it possesses such characteristics enables it to be mounted in any out-of-the-way place, as it requres no attention whatever after its installation, and should last a lifetime, and will deliver on open circuit, 8, 16 or 24 volts,



Type "S" Bell Ringing Transformer

and, fully load, 16 volts. The coils and iron are completely embedded in a fireproof and indestructible compound, which precludes any possibility of the bell-ringing circuit coming in contact with the 110-volt circuit.

In testing a current of 2500 volts for one minute is applied between the primary windings and the secondary winding and case. The transformer will stand a "dead" short circuit continuously on the bell-ringing side without injury.

RECENT POWER INSTALLATION.

An interesting installation of high-tension power equipment is that in the new flouring mill of the Wasco Warehouse Milling Company at The Dalles, Oregon. This mill represents the best of modern mill construction, not alone in electrical apparatus, but along all lines of machinery, buildings, etc. The main building is seven stories high and approximately 170x80 feet ground space, built entirely of reinforced concrete and steel. The present capacity is 1300 barrels per day, and the ultimate capacity will be 2750 barrels per day after the last unit is installed.

The power equipment consists of General Electric, three-phase, 2300-volt induction motors of the following capacity, which will be duplicated with the installation of the last unit of the mill: Main drive, one 300-h.p, 2300-volt Type P motor; cereal mill, one 15-h.p., 2300-volt motor; barley and graham mill, one 50-h.p., 2300-volt motor; wheat receiving, one 35-h.p., 2300-volt motor; wheat scouring, one 35-h.p., 2300-volt motor; wheat scouring No. 2, one 15-h.p., 2300-volt motor; flour packers, one 15-h.p., 2300-volt motor; feed packers, one 15-h.p., 2300-volt motor; Humphrey elevators, two 3-h.p., 250-volt motor; automatic sprinklers, one 5-h.p., 250-volt motor.

The wiring and installation of power and control apparatus was carried out with the view of continuous service and ease of handling. The control of all motors is centralized on a switchboard located in a separate room especially designed for the purpose, the switchboard consisting of eleven standard panels, 24x72 in., mounting all oil break, overload switches with relays, etc., each switch being equipped with signal lamps, enabling the attendant to see trouble that might occur in any portion of the mill.

The compensators, except the main drives, are located at the motors, and these are, of course, equipped with no voltage protection, and are all mounted on steel frame hangers especially designed for the concrete columns nearest their respective motors. All compensators were ordered and designed for conduit entrance, and all outlets are either potheaded or enclosed in steel enclosures. The conductors to each motor in the building are entirely separate circuits, and no two motors are dependent on any one set of protective apparatus, with the exception of the main oil switch, which controls the entire load of motors. The conductors all consist of multiple, 5000-volt, lead-encased, varnished cambric-insulated cables, drawn into galvanized conduit buried in the concrete during the construction of the building.

All motor frames are, of course, grounded, as well as is the entire conduit system, the lead sheath of the cables, and all metal parts of all switches, compensators, etc., are ground separately as extra precaution, and as a protection to operators and to the system.

The various power circuits terminate at the switchboard in a terminal trough built of heavy angle iron and No. 10 gauge steel, and this box is equipped with heavy fibre brackets grounded separately as extra precaution, and as a protection to other circuits in case of trouble on any one line. From this terminal trough the various circuits are extended down in conduit to the switch terminals and potheaded directly above each switch.

All protective apparatus is provided with separate potential transformers, so that the failure of any one device does not in any manner hinder the continuous operation of the balance of the mill during repairs.

From the above description it will be readily appreciated that there is not an exposed current carrying live part of any of the apparatus, which fact eliminates all possibility of accident to employees, and insures almost continuous service so far as the motors are concerned.

The lighting of the mill consists of approximately 200 porcelain Benjamin reflector sockets of 16 in. diameter and 100-watt Mazda lamps, giving an efficient distribution of light over the entire area of each floor. Beside the regular lighting there are numerous receptacles provided for attachment of extensions in case of repairs, examination of machinery, etc.

The power and lighting installation was designed and installed by the West Coast Engineering Company of Portland, Oregon. The building was designed by Bennes & Hendricks, architects of Portland, and power is furnished by Pacific Power & Light Company.

AUTOMOBILE ELECTRIC VULCANIZER.

The Westinghouse Eletcric & Manufacturing Company have recently placed on the market an electric vulcanizer which can be used on either direct or alternating current circuits, for automobile repair purposes.

The vulcanizer is provided with a concave surface for use in vulcanizing the casing or shoe, and a flat surface, which is used for the inner tubes. This is a great time and trouble-saver, and lessens the actual work connected with vulcanizing.

The process of vulcanizing requires from 15 to 45 minutes, depending on the cut and the part to be vulcanized. In the repairing of an inner tube, the patch is placed on the tire and then clamped to the flat surface of the vulcanizer. It is essential that the vulcanizer be brought to a temperature of about 275 degrees before applying, and that this temperature be maintained throughout the process. The temperature is controlled by a rheostat and read by thermometer on the clamping board.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—American Conduit Wiring Machine Company; $250,000, shares $1 each, subscribed $5; by I. and L. Hirshfeld, G. S. Johnson, F. G. Fox and A. J. Wright.

ILLUMINATION.

VALLEJO, CAL.—The work of installing electroliers on George street will be done by the city.

CORVALLIS, ORE.—The city of Corvallis is considering the advisability of owning and operating an electric light and power plant.

WENATCHEE, WASH.—A municipal lighting and power plant is the next undertaking of Wenatchee, and already steps are being taken to this end.

RICHLAND, ORE.—If present plans materialize there will be an electric plant built in the near future for the purpose of lighting Eagle valley.

COVINA, CAL.—Plans and specifications have been ordered prepared for an ornamental lighting system to include Center, Badillo and Citrus avenues.

REDLANDS, CAL.—The Southwest Electrical Company of Redlands has been awarded the contract to install an ornamental lighting system in the business section, on its bid of $9698.

LOS ANGELES, CAL.—Sealed bids will be received up to January 20th, for furnishing and installing the necessary equipment, also electric current for lighting Hyde Park Lighting District.

WILLOWS, CAL.—The Glenn county supervisors have granted upon the application of Lawyer Harmon Elbery the petition of the Oro Light & Power Company for a franchise to operate in this city.

RIDDLE, ORE.—Richard N. Hall of Glenbrook Farm has plans for installing a hydroelectric plant with the waters of Rail Creek as a source of power for light and power purposes. The plan is having the consideration of engineers connected with the Fairbanks Morse Company.

SAN BERNARDINO, CAL.—Sealed bids will be received up to February 24th, for a gas pipe franchise, granting permission to lay and construct a system of pipe lines in, under and along certain streets and public places in the city, for the purpose of supplying residents with gas for lighting, heating and other purposes.

TRANSMISSION.

NEW WESTMINSTER, WASH.—The Canadian Western Lumber Company here will erect a new power plant and install a 1875 kw. low pressure turbine.

EUGENE, ORE.—The Oregon Electric Railway Company are preparing plans for development of the Clear Lake power project in the Cascade mountains, east of here. When completed the plant will develop 30,000 h.p.

TACOMA, WASH.—A franchise for a high tension power transmission line between this city and Dieringer to bring power from the Lake Tapps power plant has been granted by the county commissioners to the Puget Sound Power company.

KELSO, WASH.—Commissioners of diking district No. 1 are working on the proposition of constructing a power plant to generate power from the falls on Coal Creek, using the same to operate pumping stations within the Mount Solo diking district. Work will begin as soon as possible.

COLUSA, CAL.—Application has been made by the Oro Electric Corporation for a franchise to erect, maintain and operate lines for transmitting and distributing electricity in the county of Colusa, over certain routes, highways, etc. Sealed bids will be received up to February 4th.

TACOMA, WASH.—The Tacoma Railway & Power Company, L. H. Dean, general manager, contemplates spending between $500,000 and $1,000,000 on the Electron project next year. The erection of practically 10 miles of new flume and a large portion of tunnel work is included in the improvements.

PHOENIX, ARIZ.—Work is to begin at once on the high tension line from Roosevelt dam to Maimi and Globe for supplying of power and light to mines and towns. The line will be capable of carrying 45,000 volts, and will be of suspended transmission. Steel towers with concrete foundations similar to those used on the Roosevelt-Phoenix line will be used.

AMERICAN FALLS, IDAHO.—The American Falls Power Company has completed a concrete dam 1500 feet long and 12 feet high across the Snake river at American Falls, Idaho, and is now ready to install the necessary equipment for a new hydroelectric plant which will develop 4000 h.p. A. J. Wiley is the company's chief engineer, who is represented in Boise by J. L. Savage.

MOUNTAIN HOME, IDAHO.—The Crane Falls Power & Irrigation Company is installing a hydroelectric plant of four 3000 h.p. units. The transmission line will be built from the plant to the Gem irrigation district, situated on the south side of the Snake River, 16 miles west of Caldwell. Electric pumps are to be installed at Nampa Ferry and at Homedale. Smith-Kerry & Chase, Boise, are the engineers who have in hand the installation of the pumping machinery and the delivery of the water. As the Crane Falls plant will not be ready for service for a year or more, the plan is to acquire power elsewhere next spring, so as to supply water to the land for the 1913 season.

SAN FRANCISCO, CAL.—That it may complete the construction of the great dam and reservoir at Big Meadows and provide for new equipment and extensions, the Great Western Power Company has applied to the railroad commission for permission to issue first mortgage 5 per cent 40 year gold bonds to an amount sufficient to yield $3,971,731. Following are the purposes for which the company would put out the large bond issue: Distribution, lines and service connections to consumers, to care for new business, $709,195. Construction of transmission tower line, 15 miles from Moraga valley to the south side of Carquinez straits, substation at Carquinez terminal of line; transformers, etc.; new armored cable under San Francisco bay; auxiliary line from Napa to Santa Rosa; second circuit from Carquinez straits to Napa; new armored cable beneath the waters of Carquinez strait; 4000 kw. motor generator set at Fruitvale, etc., $362,602. Extension of Big Bend power house by completing installations of units No. 5 and No. 6, $639,627. Completion of Big Meadows dam and reservoir, $1,075,800. Acquisition of lands in Big Meadows reservoir site, $200,000. Other additions to property, $23,819. Reimbursement for moneys expended on Big Meadows lands, $679,905. Reimbursement for moneys expended for plant additions, $280,783.

TRANSPORTATION.

HUNTINGTON PARK, CAL.—Victor G. Kleinberger has been granted a franchise to construct and operate a single or double track electric street railway in this city.

MEDFORD, ORE.—The M. P. McInney Realty Company, a $1,000,000 concern of Oakland, Cal., are applying for an interurban electric trolley line franchise in this city. If the franchise is granted work will begin within 90 days.

OREGON CITY, ORE.—Mark Woodruff, an official of the Portland, Eugene & Eastern Railway Company, is authority for the statement that work on the line from Portland south will be commenced in the spring. Approximately 40 miles of line will be built.

ORANGE, CAL.—Notice has been given the Board of Supervisors that the Pacific Electric Company has petitioned for a permit to construct a trestle across the entrance of Alamitos bay for the extension of its line between Long Beach and Bay City.

LOS ANGELES, CAL.—A petition, bearing the signatures of 1500 persons, asking for improved car service on the West Jefferson street line, has been presented to the city council. A double track is urged from Arlinton to Fourth, which now contains only a single track. The petition asks that the line be extended to the city limits at Ninth avenue and also double tracked.

SAN FRANCISCO, CAL.—The Board of Works has taken action to have the public service corporations remove prior to February 11 their manholes, conduits and other underground structures from the line of the municpal railway tracks which are to be laid on Market street, between Geary and Sutter, so that there may be no delay in the construction of these tracks after the work is started.

STOCKTON, CAL.—Negotiations have been completed for the purchase of $750,000 worth of Tidewater & Southern Railway bonds by J. W. Goodwin, president of the Oro Electric Corporation. The railway company, which is now operating two trains a day between Stockton and Modesto, will be in a position now to complete its electrical equipment and continue its line to Turlock. The bonds which the Oro Company has purchased pay 6 per cent.

PHOENIX, ARIZ.—President C. C. Lewis of the Salt River Valley Electric line, known as the "White Line," has asked for a right-of-way over the county roads between Phoenix and Mesa, via Tempe. The route of the White Line leads east on Van Buren street to the city limits, thence north one-half mile, thence east to Salt River. The line will cross the river on a bridge which will be constructed east of all the bridges now constructed, or in course of construction, by the company itself. Work is expected to start about February 1.

OAKLAND, CAL.—In an effort to induce the Oakland & Antioch Railway to make good its promise to establish an Oakland terminal depot near the downtown business district, a committee of the Merchants' Exchange will confer with the management of the railway. When the promoters of the Oakland and Antioch Railway began operations in Oakland four years ago, the leading spirits in both the Merchants' Exchange and the Chamber of Commerce agreed to lend their influence in the securing of rights of way for the new road with the understanding that the terminal should be established within six blocks of the Oakland City Hall.

SAN RAFAEL, CAL.—The third-rail electric system of the Northwestern Pacific will give way to the overhead trolley between San Rafael and San Anselmo within a short time, according to an announcement made here by railroad officials. Work of double tracking the line between those points has been started. It is reported that the railroad company will apply to the trustees of San Rafael and San Anselmo at once for permits to replace the third-rail with the trolley system, and that it is also the intention of the company gradually to do away wtih the former throughout its lines in this county. It was also announced that the Northwestern Pacific is planing a much improved service between San Rafael, San Anselmo and Fairfax.

WASHINGTON, D. C.—The Great Falls Power Company, of Montana, has been granted permission to transmit over public domain under strict government regulations, power for the electrification of 450 miles of track of main line of the Chicago, Milwaukee & Puget Sound Railroad between Harlowtown, Mont., and Avery, Idaho. The grant, which is for 50 years, was worked out under the act of March 4, 1911, relating to electrical transmissions, telephones and telegraph lines. The grant is subject to readjustment every 10 years, provides for regulation of rates and service, the sale of power to the United States, the states and cities at as low rates as is given any other buyer, and prohibits the transfer of the permit without the approval of the Secretary of the Interior.

TELEPHONE AND TELEGRAPH.

SOLEDAD, CAL.—The residents of the Mission District have installed a telephone line which shall be known as the Mission Rural Telephone Company.

FORSYTHE, MONT.—The Forsythe telephone as a local institution went out of existence January 1st, becoming a part of the Mountain States Telephone Company's system in this State.

ELSINORE, CAL.—The Southwestern Home Telephone Company has been granted the right to erect and operate a telegraph, telephone, electric light, heat and power line in and along the public streets of this city.

SAN FRANCISCO, CAL.—An initiative petition bearing 10,000 signatures has been filed with Registrar Zemansky calling for an election on a proposed ordinance which provides for reductions of telephone rates ranging from 15 to 20 per cent lower than those now in force. The election commission has 10 days in which to verify the signatures, after which the supervisors must order an election to be held within 30 days after such order is made. A general cut of practically all telephone rates, including business, professional, residence, extension, private branch exchange and coin machines is proposed in the ordinance which the petitioners present. The bill would also require all telephone companies to file with the supervisors and mayor a complete inventory of their entire physical property.

WATERWORKS.

SAN FRANCISCO, CAL.—Bids have been called for by the Exposition Company for the installation on the exposition grounds of a high pressure water system and a water service system. The bids will be open until January 28th and the terms of the contract will call for the completion of both pieces of work within from six to nine months. The high pressure system will be used for fire protection alone, and the service system for domestic purposes. The high pressure system has been planned with a view to safeguarding all property and buildings on the exposition grounds to the utmost. It is expected to make arrangements with the city authorities whereby the exposition system can be connected with that of the city. The hydrants on the exposition grounds will differ from those in use in the city in that they will all be below the surface of the ground and access will be had to them by raising a manhole cover. An auxiliary arrangement is planned so that the fireboats may be able to pump into the pipes. In all the high pressure system will be about 9½ miles long, with a pipe six inches by sixteen inches. There will be 180 hydrants so distributed that only 600 feet of hose will have to be laid in any portion of the grounds. The service system will consist of about 12 miles of four by twelve inches pipe. This system will also be connected with that of the city.